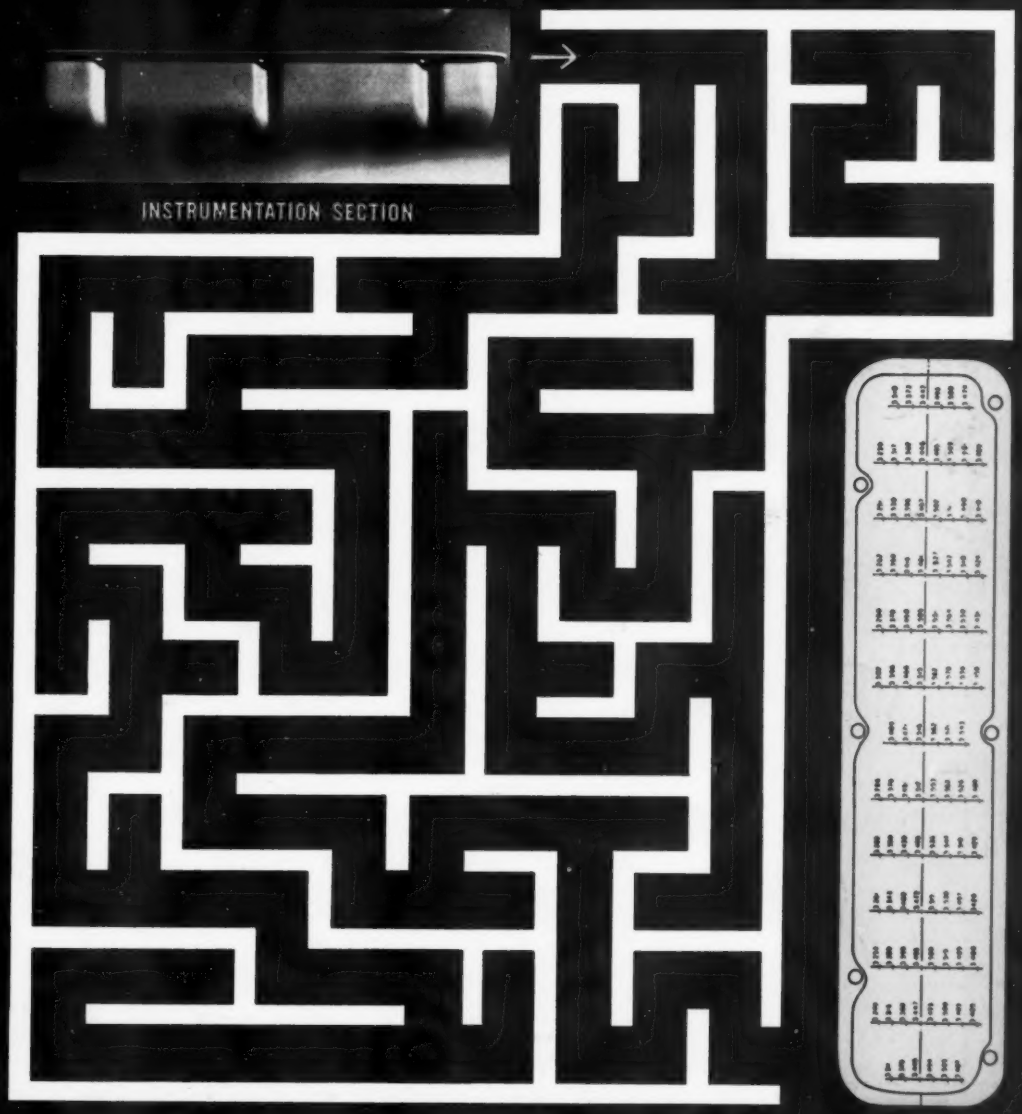
PMI

VOL.4NO.7
JULY
1961
PRICE 50c

PHOTO METHODS FOR INDUSTRY

INSTRUMENTATION SECTION



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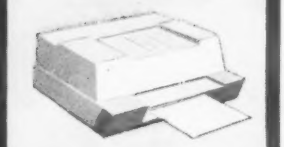

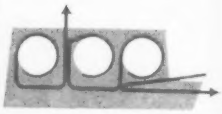

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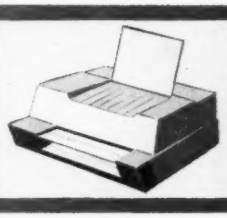

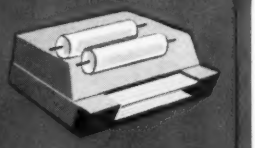

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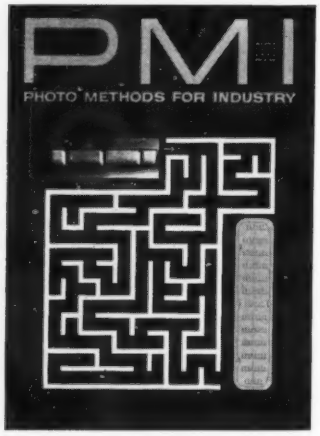

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PMI—Photo Methods for Industry is published monthly by the Gellert-Wolfman Publishing Corp., 33 West 60th St., New York 23, N. Y. Plaza 7-3700. Mid-west: 6316 N. Lincoln Ave., Chicago, Ill. Irvington 8-4242. Coast 13016 Victory Blvd., N. Hollywood, Calif. Triangle 7-7917. Copyright 1961 NPD Corp. Single copies 50 cents. Yearly subscription price, including the PMI Directory published in Oct. in addition to the regular issue, is $5.00 in U.S.A. and Canada. Elsewhere $10.00. Editorial contributions must be accompanied by return postage and will be handled with reasonable care; however, the publisher assumes no responsibility for return of unsolicited photographs or manuscripts. SUBSCRIBERS: Send subscription inquiries and address changes to Circulation Manager, Photo Methods for Industry, 33 West 60th St., New York 23, N. Y. Give old and new address, including zone number, if any. Enclose address label from last issue and allow five weeks for change to become effective. POSTMASTER: Send form 3579 to Photo Methods for Industry, 33 West 60th St., New York 23, N. Y.

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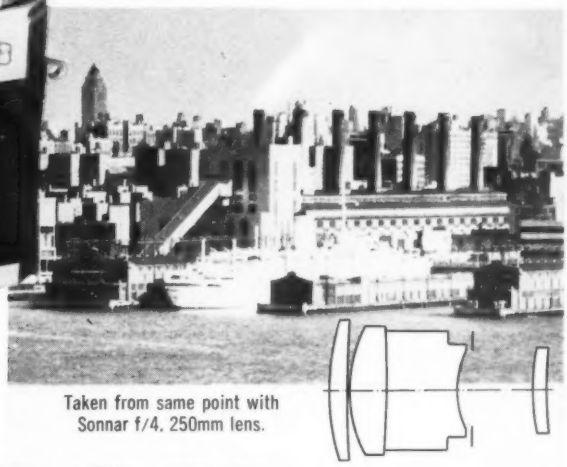

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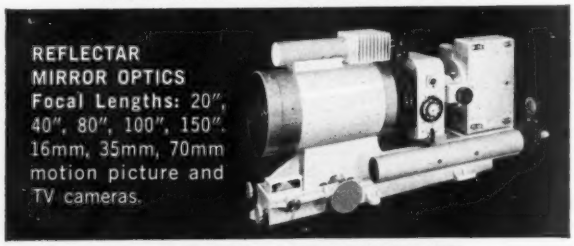

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F.Y.I.

Promotions at North American Aviation were announced by **Buzz Holland,** Chief of Photographic and Reproduction Services. **Warren Boggs** was named General Supervisor of Photographic Services and **Mark Keith** General Supervisor of Printing and Reproduction.

Other promotions include **Marvin Marker** to Supervisor and **Eugene Anderson** to Assistant Supervisor of Reproduction Services. **Frank Grode** and **Tom Jones** were appointed Supervisor and Assistant Supervisor respectively of Printing Services.

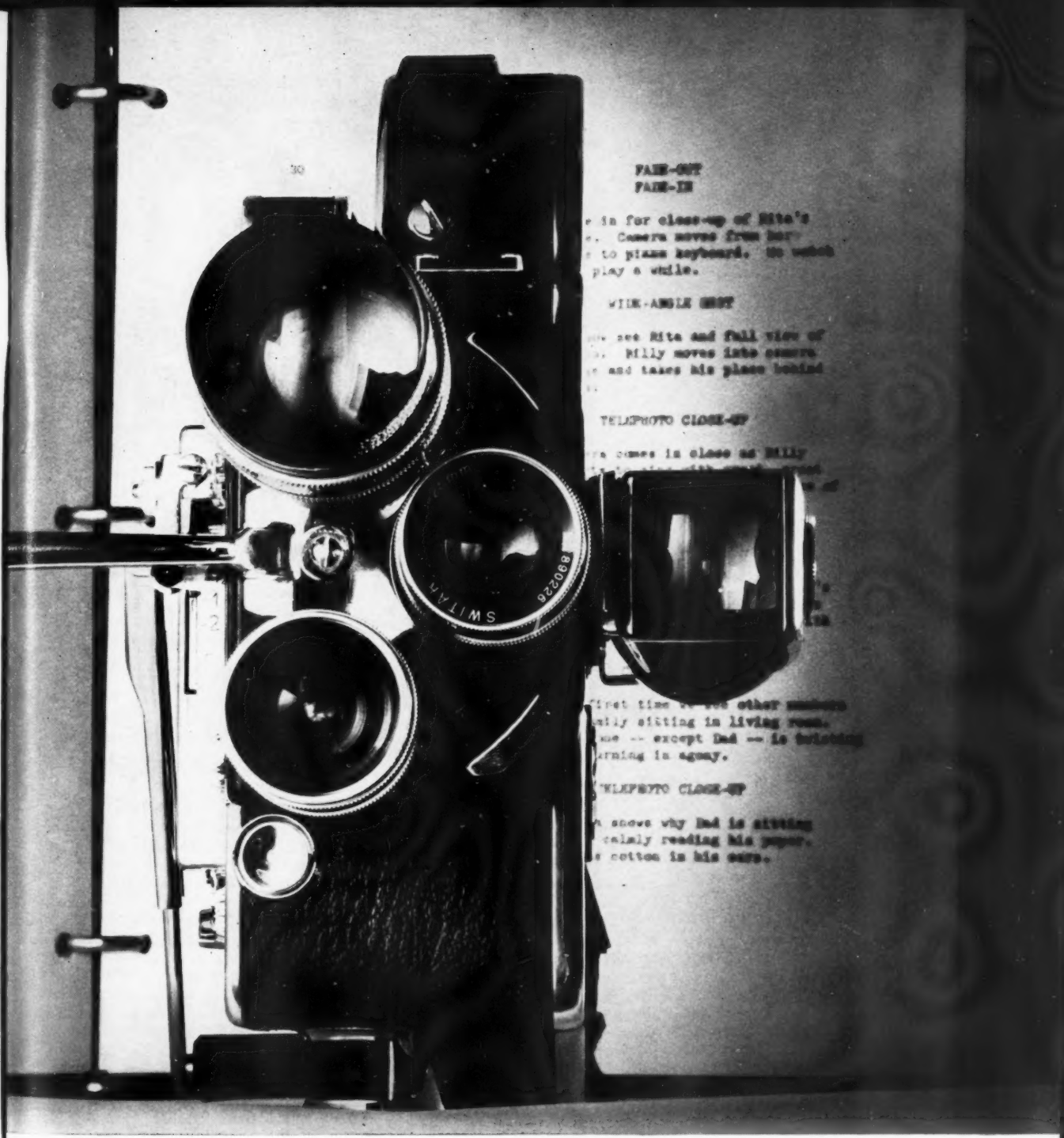
Officers for the 1961-1962 year of the Industrial Audio-Visual Association were selected at the Annual National Meeting. The slate was headed by President **Kenneth E. Penny,** Minnesota Mining and Manufacturing. **Bill Pratt, Jr.,** AT & T, and **James Craig,** General Motors, are 1st and 2nd Vice-Presidents, respectively. Illinois vp is **John Hawkinson,** Illinois Central RR. Other officers include: **Harold Daffer,** Minneapolis - Honeywell, Sec'y; **Frederick Woldt,** Illinois Bell Telephone, Treasurer; **Harvey Plants,** Birds Eye Division, General Foods, Eastern Director; **William Morris,** Baxter Laboratories, Central Director, **Howard Williams,** Edward E. Johnson, Inc., Northern Director; **Robert Strickland,** Lockheed Aircraft, Southern Director; **Vincent Hunter,** Union Pacific Railroad, Western Director.

Committee chairmen include: **William J. Connelly, Lawrence Warnock, Charles Fox, Robert McCaslin, Roy Mumma, H. Leroy Vanderford** and **Daniel Rochford**.

As a short-time "old newspaperman," we are intrigued by the large number of former newsboys who make good compared with the extremely small number of former newspapermen who hit the big time. Cause of our current cerebrations is an announcement that **John R. Benn,** who started as an after-school newsboy at Bell & Howell's Lincolnwood plant was named top salesman of photo products for the year. Along with the honor went $500 and an engraved clock, presumably symbolizing the intimate relationship between time and money.

The "G" Award of the Germain

(*continued on page 23*)



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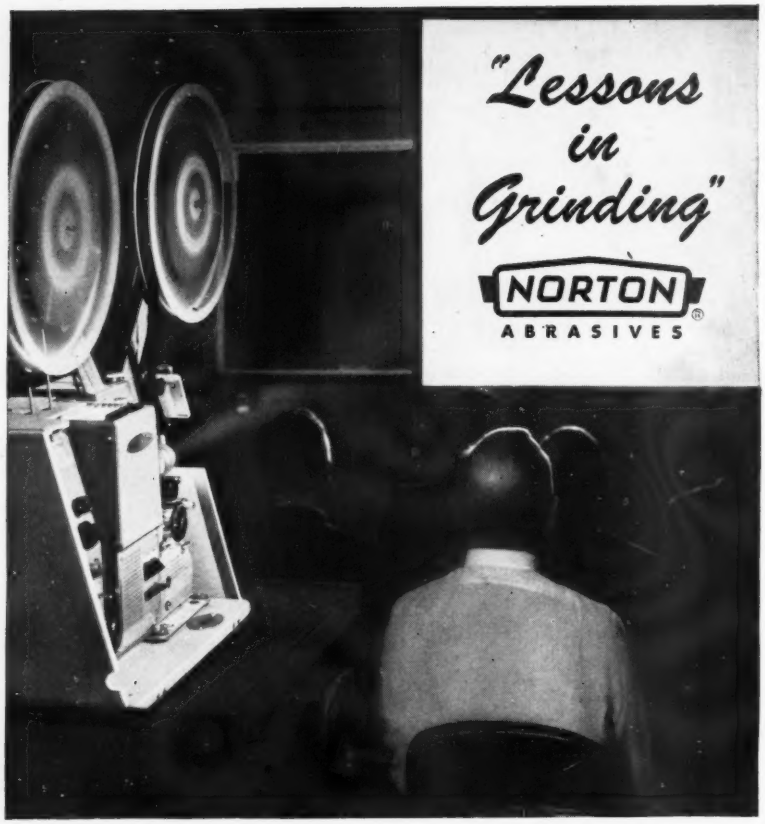

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It is quite a tribute to the performance of Kalart/Victor projectors when they are first choice of a firm with as much audio-visual experience as Norton Company.

Norton Company, a leading producer of abrasives, has been using motion pictures for 35 years. Ever since 1926 when Norton's first film was made, motion pictures have played an increasingly important role in the company's sales promotion, training and public relations activities. For example, the Norton School of Grinding uses a series of 16mm sound films especially produced to help in training the firm's own sales personnel, its distributors' salesmen, and foremen and supervisors of companies who work with Norton abrasives.

If you have an active film program such as the one at Norton Company—or are now building up to it—Kalart/Victor projectors have a lot to offer. Here are a few specifics.

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COMING UP

JULY 16-20 National Institute for A-V Selling, courses for A-V businessmen. Indiana U., Bloomington, Ind.

JULY 22-25 National Audio-Visual Convention. Morrison Hotel, Chicago.

JULY 30-AUGUST 4 Professional Photographers of America, Inc., 70th Annual Exposition of Professional Photography & 9th National Industrial Photographic Conference. Statler Hilton Hotel, New York, N. Y.

AUGUST 19-23 Techniques of High-Speed Photography Seminar, directed by Professor Harold E. Edgerton. MIT, Cambridge, Mass.

AUGUST 21-24 Biological Photographic Association Annual Meeting. Pick-Congress Hotel, Chicago.

SEPTEMBER 6-8 ISA, AIEE, IRE Joint Nuclear Instrumentation Symposium. N. Carolina State College, Raleigh.

MONTHLY MEETINGS

Association of Federal Photographers Meetings every third Wednesday at 8 p.m. G.S.A. Building, 7th and D Sts., S.W., Washington, D. C.

Binghamton Chapter SPSE Meetings every third Tuesday. Contact H. G. Morse, Ansco, Binghamton, N. Y. RA 2-4221, Ext. 573.

Boston Chapter SPSE Contact John Taylor, Itek Corp., 10 Maguire Rd., Lexington, Mass., VO 2-6200.

Chicago Chapter Biological Photographic Assoc. Meetings every third Tuesday. Contact Dorothy Pinkham, 551 W. Grant Pl., Chicago. DI 8-6400.

Cleveland Chapter SPSE Meetings the first Tuesday of each month. Cleveland Engineering & Scientific Center, 3100 Chester Ave., Cleveland, Ohio. Contact Robert E. Birr, General Electric, Nela Park, Cleveland. GL 1-6600.

Manhattan Chapter Society of Reproduction Engineers Meetings every third Monday. Contact J. Ryerson, Joseph Dixon Crucible Co., Newark 2, N. J. Telephone DE 3-3000.

Industrial Photographers of America Essex House, Newark, N. J. Meetings every second and fourth Thursday. Contact Tom Holberton, 181 Lake Drive West, Packanack Lake, Wayne, N. J. or R. Handley, The Port of New York Authority, 111 8th Ave., N.Y.C.

Midwest Industrial Photographers Association Contact John E. Scrage, c/o Deere & Co., Photo Department, 3300 River Drive, Moline, Ill.

National Visual Presentation Association, Inc. New York City. Meetings every second Thursday. Contact M. E. Shack, 19 W. 4th Street, New York, N. Y. Telephone MU 2-2294.

New York Chapter SPIE Meetings every third Thursday. Contact Don Bass, P.O. Box 177, Bethpage, L. I., N. Y. Telephone Liggett 4-8196.

New York City Chapter SMPTE Meetings first or second Wednesday of each month. Contact Ed Warnecke, Eastman Kodak Co., 342 Madison Ave., New York, N. Y. MU 7-7080.

New York City Chapter SPSE Monthly programs. Contact Richard H. Haard, Bell Telephone Labs., N.J., CH 3-1000, Murray Hill Ext. 2182.

Northern California Chapter Biological Photographic Assoc. Meetings every 4th Friday. Contact Cecile D. Kinney, U.S. Naval Radio-logical Defense Laboratory, San Francisco, Calif. Code 227 MI 8-6900 ext. 564.

Rochester Chapter SPSE Second Thursday. Contact Woodlief Thomas, Jr. Color Technology Division, Building 65, Kodak Park, Rochester 4, N. Y. Telephone CO 6-2500.

Rocky Mountain Industrial Photographers Meetings every fourth Monday. Contact P. H. Broadie, 2170 S. Lincoln, Denver 10, Colo. PEarl 3-2200.

Southern California Chapter, Biological Photographic Assoc. Meetings every third Thursday. Contact Avis Gregersen Warner, Box 78, 1200 N. State St., Los Angeles 33, Calif. Telephone CA 5-3131 ext. 7-1319.

Southern California Chapter SPSE Meetings the last Monday of each month. Contact Ben Augustine, 235 Annandale Rd., Pasadena 2, Calif. Telephone MU 1-0076.

Southern California Chapter Industrial Photographers Meetings every third Tuesday. Contact Janet Marshall, Executive Secretary, 5463 Virginia Ave., Los Angeles 29, Calif. HO 5-6614.

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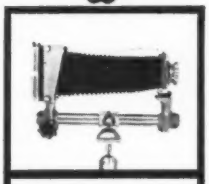

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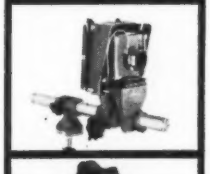

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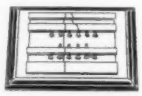

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WORKING PHOTOGRAPHER

More comments on methods and techniques: tricks of the trade

Last month I talked about the program conducted each year by Jim Hampson of Shreveport, La., at the National Industrial Photographic Conference where members of the audience—working industrial photographers—get up and show some clever gadgets or gimmicks or ideas or tricks they have come across during the year to make photography easier, to save money or time, or to do something that might not be done otherwise. This is one of the most interesting programs of the entire conference and is well worth attending. (I am presuming, of course, that *you* are coming to the Ninth National Industrial Conference in New York City, July 31-Aug. 4th. If not, your boss is cheating himself, as well as you!)

Last year's conference had a fine display of ingenuity, and I will continue to pass along some of the ideas exchanged there.

Cast-offs and close-ups

Ross Sanddal of Hughes Tool Co., always full of bright ideas showed some interesting gadgetry such as the use of cast-off Ansco 8mm movie film reels for spooling tape for portable tape recorders.

He reports that they do many close-up photographs of metal parts for engineers who want to see specific areas or details in the sample submitted. Ross uses an Ednalite Powerscope for this purpose. This is a magnifying glass of variable power with a built-in light source. The engineer orients the sample under the magnifier until he gets just the angle and field he wants; Sanddal's boys then photograph right through the Powerscope.

One of Sanddal's neatest tricks uses a lens shade through which he sawed a slot about a third of the way—as though he were about to slice off the front end. He uses this slot to hold a small piece of a broken dark slide, about 3 x 1 in. When Sanddal sets up a large interior scene where the banks of fluorescent lights show in the picture, he obscures them by carefully positioning the black mask to cover them, checking his effect in the ground glass. This eliminates flare at the edge of the picture. When he wants the fixtures to actually show in the photograph, he carefully covers them, makes his regular exposure, and then a brief 1/25th of a second exposure more with the mask out. In this way he does not overexpose the fixtures. When Sanddal shoots transparency color under High-bay mercury lights where, because of the color of the light, color transparencies have a greenish cast, he rates the film at higher speed, pushes the first development, but holds the color development to normal time. Ordinarily this would make for reddish transparencies—but here, more red is just what is needed!

At this point Jim Hampson told of having to make reductions in the enlarger for lantern-slides or small prints, and not wanting to bother using the extension cone normally used to extend the lens farther from the negative, he simply slips on close-up (portrait) lenses on the enlarger lens, giving an effectively shorter focal length lens and achieving the same effect. Jim also gave an excellent suggestion for working with flash or strobe in explosive atmosphere where it is necessary to keep any spark in the system from causing an explosion. Jim says he puts his strobe lights in plastic bags and then runs a hose of nitrogen into them, allowing it to inflate the bag and slowly leak out. Since the pressure in the bag is greater than that in the atmosphere, no explosive vapors can flow into the bag; danger of an explosion is thereby averted.

Ken Knollenberg of Bethlehem Steel showed some excellent pic-

(*continued on page 12*)

ANNOUNCING

A NEW ERA IN 8"X10" ENLARGING

THE ALL-PURPOSE, COMPACT DURST V-184

Durst, maker of precision photo-technical equipment for over twenty-five years, has pioneered again to bring you the most versatile, compact, efficient machine ever made for 8" x 10" and smaller negative formats...at a cost far below that of comparable enlargers.

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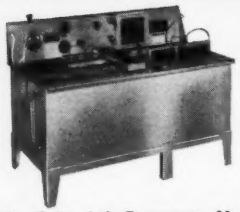
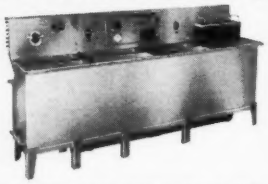
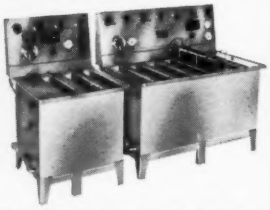
Get more information. Circle 428, page 77



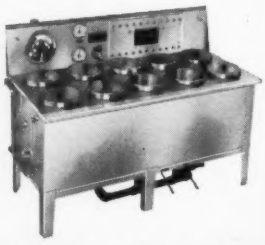
Rolor Color Lab Processor, Model CL-1 Meets the color film and print requirements of the studio and small industrial service laboratory.



Rolor "Pro-10" 16 x 20 Color Print Processor A production unit that features the most precise regulation controls for temperature, step timing and agitation.



Rolor Split-C Color Print Processor, Model 20-10P The most widely used processing unit for the highest custom production of quality color prints.



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Get more information. Circle 489, page 77

(continued from page 10)

tures made of industrial locations against a sunset. Normally these are made by double exposure, the first exposure being made at dusk and sunset, and the second one, much later at night to record artificial illumination. The only problem is that normally the film cannot be changed between exposures without mis-registering the two images. Ken says he found a method which permits him to make several bracketed shots while maintaining registration with sheet film holders. He fastens each sheet of film in film holders securely with Scotch Tape so it doesn't shift while being handled. He anchors the tripod securely. He has registration marks on the camera and film holders so every time a holder is inserted, it is pushed in all the way and then down. He checks finally to see that the registration marks line up. Now he can make a series of pre-exposures and be sure the holders go back to the same spot each time.

Calling his shots

Joe Brubaker then showed a cute technique of using a proportional scale dial to determine what areas are included with various focal length lenses. He sets film width opposite film-to-lens distance (focal length is a good enough approximation except for close-ups). This is the same proportion as the lens-to-subject distance vs. field covered, which can be read directly off the scale. Brubaker's book *Keemag Solutions in the Use of Lenses,* is an excellent handbook, by the way, for most any optical calculation a photographer needs to make.

Pat Cannon of General Electric Company showed slides of an ingenious gadget which adapts a copy camera for making 35mm transparencies of flat copy. He has mounted an elevator tripod head in a spare lens board of a Robertson camera. A 35mm camera goes on this tripod head for shooting copy held on the camera copyboard. Pat also uses a Densichron on the ground-glass of a Leica Visoflex housing to read exposures for his slides. By setting up some standards, he can then read exposure directly, accounting for bellows extension, magnification, etc.

Jay Oistad of Tyler, Texas, showed a cute safety device: in color printing, one can ruin a sheet

(continued on page 85)

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Here in one kit is everything you need for just about every kind of photography.

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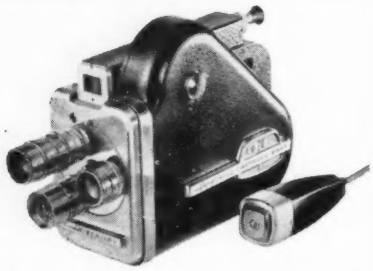

COLOR, ACTION, SOUND for $2.00 PER MINUTE.....

Seems impossible, but it's true. Photographers across the country are already making 8mm motion pictures with sound, easily and at surprisingly low cost. It's a one-man camera, and its color-sound film costs only $11.00 (with processing) for five minutes of showing time.

The Cinephonic is being used to produce documentaries, safety films, training courses, sales presentations, engineering reports — films that were nearly impossible before.

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INDUSTRIAL PRODUCTS DIVISION

Get more information. Circle 431, page 77

Lloyd E. Varden

PHOTO METHODS FOR TOMORROW

Taking pictures inside holes is anything but a novel technique

Now and then an article appears in the literature describing a particular method by which an industrial photographer has found it possible to photograph the inside of a gun barrel or the characteristic patterns of different geological layers below the earth's surface during a drilling operation. The terms "borescope" and "borescopic camera," which have been adopted in these applications, are becoming fairly commonplace in certain areas of industrial photography. But the techniques employed are still considered to be very specialized. It is surprising that so many photographers find it difficult to visualize how it is possible to take a picture of a specific area far inside a hole whose diameter is too small to accept their smallest camera. But even if their camera "just fits," they might still wonder how the area to be photographed can be illuminated.

Medical Photo-techniques

It's unfortunate that the first industrial photographer who was confronted with the problem of taking a photograph inside a fairly small hole did not consult an experienced medical photographer. If he had, he would have learned that the only way medical photographers normally can take pictures of things happening inside the body is through the body orifices, e.g., the mouth, the ear, the nose, the anus, etc. There is only one normal exception, namely, the eye. The retina, for example, is inside the exterior envelope of the body, yet it can be photographed directly. No orifice is involved. (Of course, transparent plastic plates can be surgically introduced in various parts of the body to *abnormally* present a view of some internal actions of the body.)

At least 99 per cent of the time, photographs of the interior parts of the body are taken through the normal orifices. The instruments used to examine these interior parts of the body are known generically as endoscopes. Their specific names, of course, depend upon their application and functional design. A *gastroscope*, for example, is a fairly flexible endoscopic instrument, so designed that it can be inserted through the nasal orifice into the stomach. A proctosigmoidoscope, though, is a rigid endoscope of sufficient diameter and length to permit an examination of the sigmoid area of the lower intestine, via the anal orifice.

Still and motion pictures—even color—have been taken successfully through all of the common endoscopic instruments by medical photographers. Considering the complexities of the problems in nearly all cases of endoscopic photography, it is a wonder that most details now have been carefully worked out and special equipment designed to reduce routine difficulties to a minimum.

Joseph D. Brubaker, Evanston, Illinois, has not only produced some of the finest endoscopic equipment ever made, but he also published recently a treatise on the subject in which he discloses everything, it seems, that one would want to know about the subject. He not only discusses foreign-made equipment to a far greater extent than that of his own, but he gives sketches of various optical and illumination systems, calculation examples, several useful tables and an extensive bibliography. I love a guy like that. Few of them are left. Incidentally, the title of his treatise is "The Fundamentals of Still and Motion Picture Photography and Television Through Endoscopic Telescopes." Address: J. D. Brubaker, 949 Sherman Ave., Evanston, Illinois.—THE END

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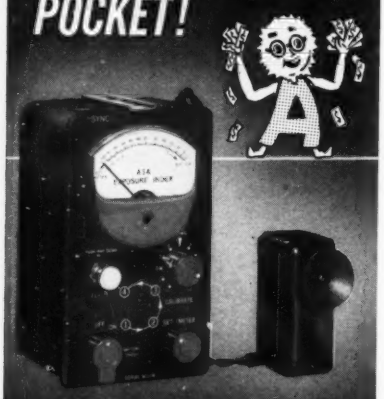

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Edward R. Farber

ELECTRONIC FLASH

Double - barreled crimestopper has 500 W-S flash; new repeater

We photographers are soon apt to become victims of our own progress. Minneapolis-Honeywell has started marketing a new imported device called the Traffic Pax which makes a visual record of traffic offenses and makes violators the picture of guilt, night or day.

Though the French used such a device as early as 1954 (described in the French book *Flash* by Rebikoff), the present device is a more elaborate version made by Traffic Pax Vertrieb in Dusseldorf, Germany, and equipped with a far more powerful electronic flash unit of 500 watt-seconds.

Who, what, when, where, how

Two sequence cameras are mounted on the dashboard of the patrol car and controlled by a push-button. These make 55 frames on one 35mm 36-exposure roll, running 18 shots without rewinding, as fast as five frames per sec. One camera has a 38mm lens, the other a 75mm telephoto. The wide angle shot includes a clock speedometer in its field of view which shows time and date as well as speed. A trunk-mounted pack powers the top-mounted flash, which is said to have a range of 150 ft.

For recording speeding, the officer pushes a button three times at five-second intervals; the order and intervals of course are shown by the clocks second hand. The relative size of the vehicle image will indicate if the patrol car was gaining or lagging.

Traffic Pax on Denver patrol car

The system will be an invaluable aid in recording all types of violations including that of the impeder as well as the speeder. It is felt that the reduction in time spent in court by arresting officers will amply justify the cost of the equipment.

Can you hear a couple of officers after a court session? "I really nailed this guy with only three shots . . . f/11 . . . five minutes in Speeders Special . . . Ansdak Copswin film. Best in a pinch I always say. The judge praised my arresting composition . . . said I really put this guy on the spot, but I guess it went against his grain. Said he had never been exposed like this before. Wonder if that doll he had his arm around was his wife?"

Anyway, the device should not only prove valuable for regular police work, but for truck and cab checkers, driver training schools, and studying the behavior of drivers at certain intersections, safety islands, etc. It may be used to record accident scenes, too. Doubtless we will see many enterprising newsmen making open flashes from the squad car's light.

From now on when I drive in Denver at night, I am going to have my flash unit aimed out the rear window with the photo cell plugged in, but 500-WS at five per second sounds like tough competition.

Middle-size repeater

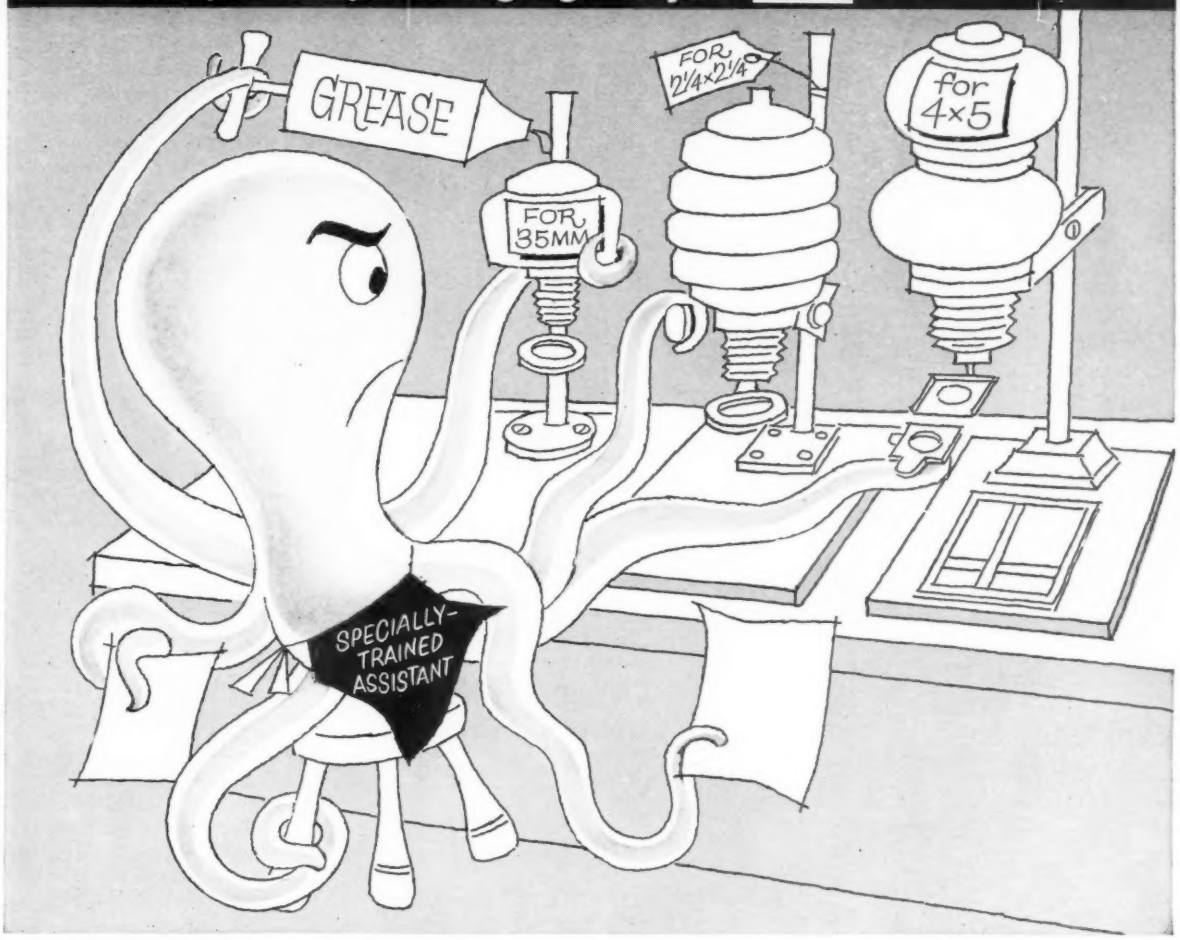
Just received the following from William Cox, sales manager of the Chadwick-Helmuth Company, 472 East Duarte Road, Monrovia, California:

"Dear Mr. Farber:

"We always enjoy your column, and compliment you on the good

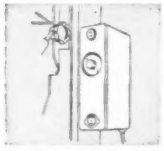
(*continued on page 18*)

How to speed up enlarging—if you don't own a Beseler



New Beseler speeds up enlarging—automatically

Beseler builds speed and versatility into the new 45AFM with these unusual features



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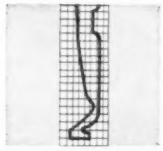

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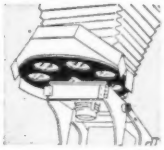

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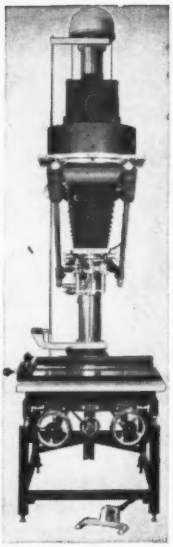

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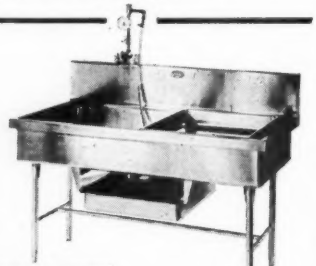

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ELECTRONIC FLASH

(*continued from page 16*)

reporting that you do on items of interest month after month.

"Your comment in the March 1961 issue, 'I am most frequently asked about buying, building, or renting a repetitive flash unit' particularly caught my eye.

"We manufacture for marketing by Flight Research a very fine instrument of this type, per interim data enclosed. It fills a big void between the $3000 E G & G units repeating thousands of times a second for scientific instrumentation purposes, and the conventional press flash unit. It does not have the watt-seconds per flash of the press flash, but it does offer a good assortment of very useful intensities at moderate cost.

"If further details would be of help, we or Flight Research would both be very much at your services."

The unit and suggested uses are very interesting indeed. Called the Strobex model 122 Electronic Flash Unit, the device is lightweight (25 lbs.) compact and needs only 150 watts from the 115 volt AC line of 50 to 400 cycles. Repetition rates are 5, 10, 30, 100, with flash durations of 300, 200, 50, and 25 microseconds respectively. Guide number with ASA 10 Kodachrome would be 14, 8, 3 and 1. With 320 ASA Tri-X negative film, 160, 48, 20 and seven.

The light source illuminates a 50 degree cone of light with a fall off of only 30 per cent. A GE 151 Flash Tube—a heavy duty version of the FT118 is given a rating of over 36 million flashes in this service. The trigger input amplifier will operate from a contact closure, a single pulse, the output of a 20 volt RMS sine wave from an audio oscillator, or a 15 volt peak minimum square wave. Uniformity of illumination is such that intensity flicker is but plus or minus 2 per cent. Price is $460.00.

It would pay to write for information on this unit and for bulletins 4, 5A, 7A and 8B which describe methods of motion analysis by multiple exposure, photography of resonant modes, photostress methods, and a reciprocity failure chart.

Patent number 2,967,975 has been granted to R. B. Hartman II of Bridgeport, Conn. for a high speed photographic light circuit. The circuit provides a very rapid operating trigger pulse and a very short firing time. It was assigned to the Remington Arms Co.—THE END

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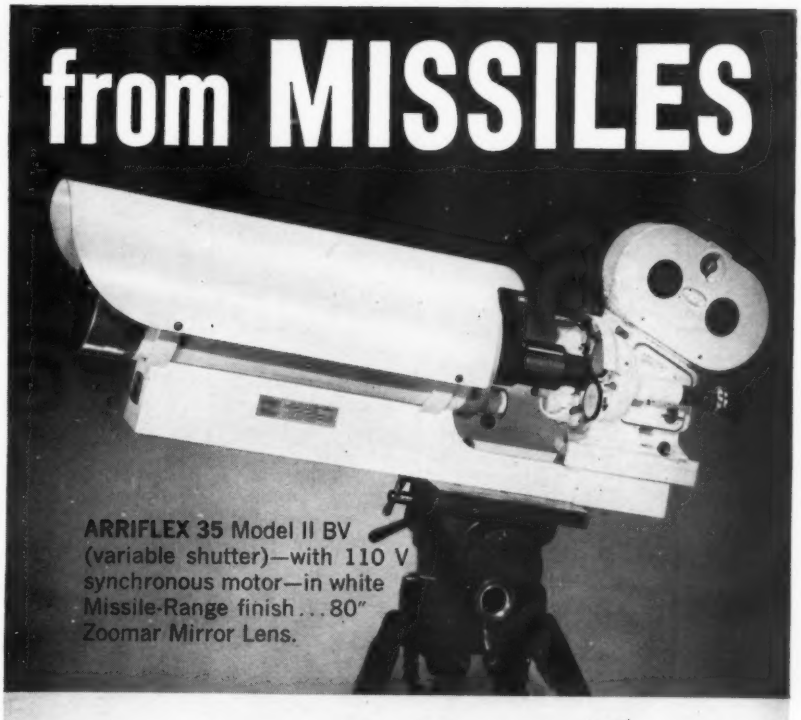
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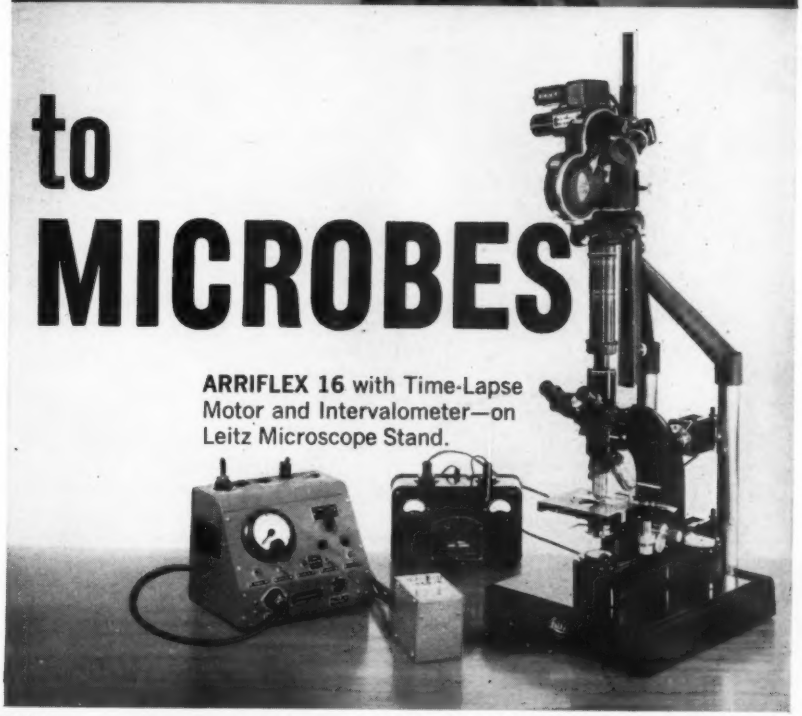

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A powder deceiving in appearance. Even dissolved into solution, its innocent appearance belies its power. Only after developing film in the solution will you see . . .

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Samuel Lang & Leonard Zoref

INDUSTRIAL COLOR

Some puzzlers on filters, reciprocity failure, E-3 processing

Mr. R.L. from Columbus, Ohio, has the following inquiry on Ektachrome processing: "I have a 3½ gallon hard rubber set-up in my darkroom. I feel it necessary, that when I come back from a color assignment, to run a test exposure or two to make sure everything was working properly in the field. In the event an error took place or there was some slight malfunction of a piece of equipment I could rectify this in my processing. I am wondering, though, if there is something wrong with my processing. I notice that when I mix my line fresh that some of the Ektachromes have a yellowish cast. This is especially noticeable when I have processed my tests one day and the balance of the job the following day.

I also have noticed the processing becomes quite reddish or magentish if the line has not been used. Is there any way that I can stabilize the line so that I don't have these problems?"

Answer: The phenomenon of having too much yellow on a freshly mixed batch of E-3 Ekatchrome is quite normal. We have noticed that whenever we have had to mix a fresh batch of first developer that our control strips show a higher content of yellow. We have been able to overcome this effect to some extent by running some fogged black-and-white film through the first developer. Old fogged Ektachrome is even better. Another problem of color was the magenta or reddish cast. We notice that he did not have this problem when he had fresh chemicals. We are presuming that he followed the mixing instructions of the color developer. If part 'A' (the oily liquid) is not mixed sufficiently this will cause a magenta balance in the transparencies. This would be noticeable though on the first run of the chemicals. The big problem is the inactivity of the developers. The color developers are highly alkaline having a pH of well over 11. The tendency of the developer is to drop back in pH on standing. The effect of lowering the pH is magenta on the film. Too high a pH will make the color balance greenish. Each kit comes with instructions for raising the pH with a solution of 10 per cent sodium hydroxide in lieu of replenishing, of course all of the above could be avoided with replenishment of the developers or with more activity of the solution. E-3 is a sensitive and difficult process.

Question: "I have a studio where about half of my work is shot. The balance is on location both indoors and outdoors. I have been using a CC10B filter on all my studio shooting with tungsten due to a low voltage condition, with pretty fair results. I use the same filter when I have to shoot outdoors when it is late in the day. As I'm always striving to improve my color, do you have any comments?"—B.C., New Orleans, La.

Answer: Yes. The CC10B filter absorbs yellow only. We doubt that this is really the excess color in your studio due to the low voltage condition. The proper filter to use would be the No. 82A filter, as this is designed to correct color temperature. It is not a pure color as it is called a bluish filter, not blue. We think that even better results can be obtained outdoors with the 82 series filters when the sun gets low in the sky. The 81 series, incidentally, comprises the opposites of the 82 series. They tend to warm up transparencies better than the pure color filters. The pure color (CC) filters are better suited to correct a color deficiency of an emulsion or to compensate for reciprocity failure of an emulsion.

Question: Mr. C.S. of New York

(continued on page 22)

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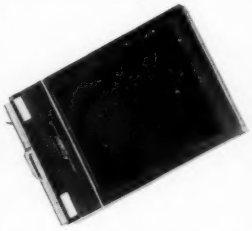

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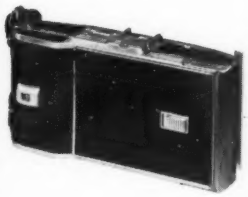

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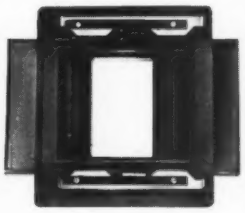

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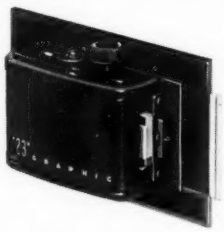

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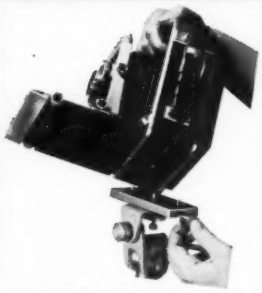

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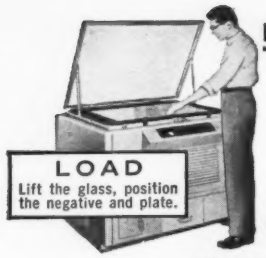

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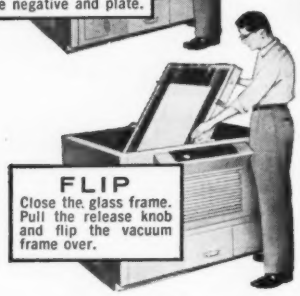

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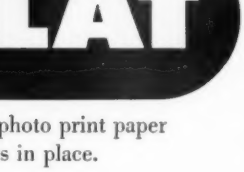
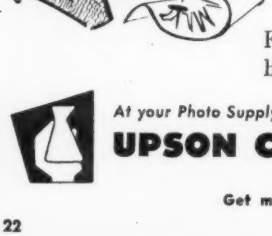


Get more information. Circle 474, page 77

struggling with curled prints?



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INDUSTRIAL COLOR

(continued from page 20)

has a problem which many may have observed and let go with a shrug of *c'est la* color. "I have been using E-3 Daylight Ektachrome outdoors and with my electronic flash and have been obtaining lovely color. The other day I decided to do a still life in my studio and got the shock of my life when the Ektas came back from the lab with the heaviest yellow overcast. I know everything was ok with the film and processing, as it was the same emulsion that I had used with my electronic flash and had sent in together with the stills. What gives?"

Answer: This problem should be brought to the attention of all photographers using E-3 daylight film. Most of the present daylight emulsions have this characteristic. The E-3 daylight is balanced and tested at 1/50 sec. Due to its high speed there is hardly any need to use longer exposure times. We have found though that when the exposure exceeds 1/25 sec. the film takes on a decidedly yellowish hue. If an exposure of longer than a second is used the yellow cast is exceptionally strong on many emulsions. This may explain some yellow transparencies you have stashed away in your file. We hesitate to recommend filtration due to the fact that every emulsion reacts differently to this reciprocity failure. Best to remember, do not use shutter speeds longer than 1/25 sec. with daylight E-3 Ektachrome.

Oops

We stand corrected on our March column where we stated that no resolution charts are available any more from the manufacturers. Ansco informs us they have a booklet on Ansco professional products for Industrial Photography. This booklet gives a capsule rundown on Ansco industrially-suited products. In a section dealing with motion picture products there is a complete table of lines per millimeter. Resolution of all Anscochrome color as well as Super Hypan negative films. We are grateful to John Larish, representative of Ansco Professional Products for bringing this to our attention.—END

PMI Goes to Bed Early

So mail early to get your news in FYI and Coming Up. Right now you should be sending items for September and October, 1961.

FYI

(continued from page 6)

School of Photography is going to **James Godbold** of National Geographic as the individual who is credited with the most important contribution to photography last year. He is credited with improving communications through modern photo journalism and promoting photo excellence. The organization award went to National Aeronautics and Space Administration.

We haven't had too many fine words for industrial designers since they took the running boards off the automobile, but occasionally, they come up with something we agree on. One of these moments of agreement is on the Master Design Award to the Balomatic 655 slide projector from Bausch & Lomb.

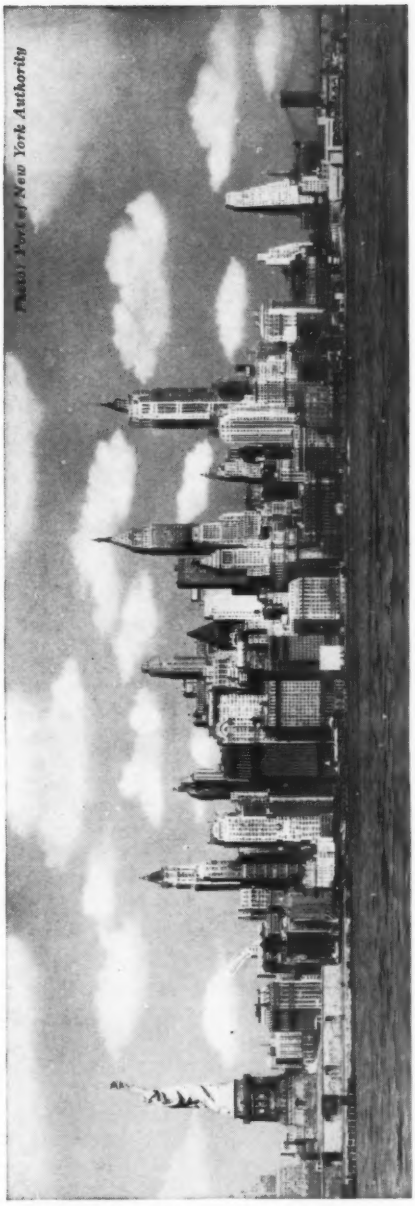
Our regard for the people at SPSE is closer to awe rather than respect. The amount of scientific brainpower represented by this group is, to a liberal arts type, amazing. Like most groups, not only do the members get recognition from civilians but they like to give each other awards. Honored by fellowship awards for "contributions to photographic science and engineering" were **Dr. Frank Back,** Zoomar; **Dr. Heinz Nitka,** Ansco, and **Admiral Robt. Quackenbush, Jr.** of Polaroid.

Named as senior members were: **George Eaton,** Eastman Kodak; **Ira Kohlman,** LogEtronics; **Joseph Mangiaracina,** Signal Corps.

Steven Levinos of Ansco's Rapid Access Recording Systems, is the new National President of SPSE, succeeding **George Eaton.** He was formerly chief of the photographic branch of the Signal Corps Engineering Labs, Fort Monmouth.

From time to time we receive inquiries as to whether or not we accept material from working photographers, either prose or photos. The answer is an emphatic YES! If you have a gadget or an idea that you think is pretty good and deserving of public notice, let us know. If you have some pictures you are proud of, let us see them. If you are promoted or change jobs or even get married, let us know. Our address? PMI, 33 W. 60th St., N.Y. 23, N.Y.

Walter Benson, Chief of the Photographic Services Section at Olmsted Air Force Base, Pa., would like to hear from in-plant photographers in the Harrisburg-Lancaster area about forming a group. Write him c/o Middletown Air Materiel Area, Olmsted AFB, Pa., or call Whitney 45521 Ext. 5138.



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Ernest E. Reshovsky

PHOTO INSTRUMENTATION

Multiple pulse radiography spots failure from shock and vibration

Standard equipment used in the field of shock and vibration testing detects failure of assemblies at certain acceleration levels and certain frequencies. To establish causes of failures a high speed camera and a vibration table usually provide the necessary answers.

For components which cannot be made visible without affecting their dynamic properties, until recently, no satisfactory technique was available. It was just about impossible to watch and record the behavior of encased components during shock and vibration tests, a matter of great interest to test personnel. It might seem that a standard X-ray unit would provide the obvious answer. Closer examination however shows that this approach is impractical.

Study demands high speed

Let's suppose that one wants to observe a sample that is vibrating on a vibration table at 500 cycles per sec. at 20 g, and suppose that an internal part of the sample is resonating with a Q of 25. We would want to see a total displacement in the order of 0.020 in. (0.5 mm) at a peak velocity of two ft. per sec. (60cm per sec.). To limit blur to 10% of the total displacement under these circumstances the X-ray recording camera must have a shutter which is able to limit the exposure time to 100 microseconds or less. Even with X-ray image intensifiers, it's impossible to get sufficient X-ray energy through the average object in such a short time if a continuous X-ray source with small focal spot is to be used.

Cooling off period

For the purpose of shock and vibration studies it is possible to turn off the X-ray source between exposures, giving the X-ray tube target the opportunity to cool. Consequently the amount of X-ray energy can be increased during exposure without damaging the tube target. Only by using this pulse technique is it possible to generate enough X-radiation to be able to get sufficient film density in exposures shorter than 100 microseconds.

The Zenith Radio Research Corp., Menlo Park, Calif., has recently developed equipment which produces X-ray pulses of one microsecond duration. According to Dr. L. C. Foster, Director of Research and John K. Landre, Project Engineer, one microsecond is short enough to stop all motion occurring in environmental testing. During this short time, X-rays are generated by an electron beam having a potential up to 150 kilovolts at a current of 130 amperes

(continued on page 26)

Ordinary (above) vs. 100 μsec. X-ray

Get more information. Circle 438, page 77

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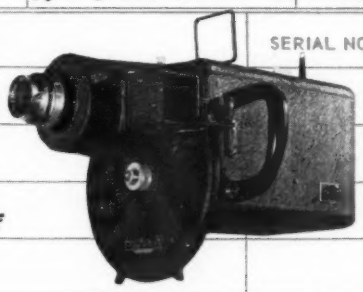

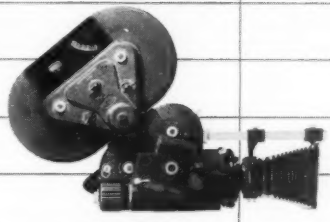

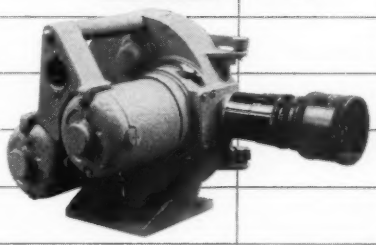

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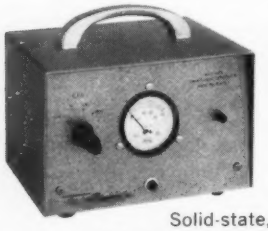

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PHOTO INSTRUMENTATION

(continued from page 24)

and these 20 megawatt pulses can be repeated at a variable rate up to 30 pulses per sec. The X-ray target, having an apparent spot size of one square millimeter, is not damaged due to overloading and the size of the source is small enough to be useful for most subjects. The X-ray energy per pulse is sufficient to make radiographs directly on film and is also powerful enough to penetrate up to two inches of aluminum.

Stroboscopic technique

The repetition rate of 30 pulses per sec. would, at first sight, seem to limit the use to vibration testing at frequencies up to only 30 cycles per sec. However an apparently stable image can be obtained at much higher object frequencies, i.e., when the vibrating frequency is a multiple of the flash frequency. In vibration testing one is not interested in a stable image because it does not contain information about resonating components. Just as with visible light stroboscopic techniques it is possible to introduce a slight change in phase difference between the subharmonic of the vibrating frequency and the flash frequency, thus establishing apparent slow motion. There is electronic equipment made by Chadwick-Helmuth available which automatically supplies the strobe frequency F for a certain preset slow motion frequency Δ f, when it is supplied with the vibrating frequency f. It calculates

$$F = \frac{f + \Delta f}{r},$$

where r is an integer chosen by the apparatus such that F is always less than 30 cycles per sec.

Quicker for Shock

For shock testing a slightly different technique is applicable. In this case the duration of the phenomena is normally limited to time periods of the order of 10 milliseconds. The repetition rate of the Zenith equipment is 30 per sec. and it would seem impossible to make more than one exposure during the time period of 10 milliseconds. On the other hand, a limited number of exposures such as 10 to 20 are usually sufficient to record all information during a shock test. This makes it possible to go to a higher repetition rate for these short periods of time. It is feasible to con-

(continued on page 85)

Special report to
professional photographers
from The FR Corporation

The breakthrough in 3-Tray color print processing

You've probably read about The FR Corporation's new simplified color print process. And you probably know that it is the first and only color process that requires just three baths. (Developer, 5 minutes — Fixer, 3 minutes — Bleach, 10 minutes.)

But you may not know that paper and chemicals will soon be available in professional sizes. That color stability—saturation—and brilliance of the FR Color Print System are completely professional in every respect.

Its whites *are* white. Its reds are brilliant and saturated. Its fidelity in all other colors is up to strictest professional standards.

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This new color system lets you work under relatively bright safelights during the "dark" part of the process. And this "dark" portion lasts as little as *seven minutes —shorter than any other color print system.*

Judge exposure after only seven minutes

Once you've turned on the room lights (after the print has been fixed one minute of its total three minutes) you can accurately judge whether the density is correct.

The print at this point is somewhat sepia colored since it still contains unbleached silver. However, after you've gained experience with the process you can take an educated guess about your color balance even at this point.

When the print is in the final wash (within 24 minutes of your starting time) you see the colors exactly as they appear when the print is dry. No need for guessing —you can tell definitely whether or not your filtration is correct.

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Temperature control of solutions is no great problem. It is far less critical than with other color systems. In fact, you can work within quality black and white tolerances and get brilliant results.

Perhaps even more important—*FR Color Paper can be stored without refrigeration—without changing characteristics.*

Use regular black and white equipment

Any professional black & white darkroom is set up to handle color with FR materials. You don't have to invest in specialized color equipment to do color work. Your standard sinks, trays, timers, thermometers and enlargers are all you need for the new FR Color System.

And of course if you're already set up for color processing your equipment is perfectly usable with FR Color. In fact, it will operate more efficiently than ever before because FR's three bath system takes less time and takes up less space.

What FR Color means to professional photographers

Now every darkroom can handle color—without a major investment in equipment or space. Now every studio, every commercial photographer, every wedding photographer, can use the magic of color to increase sales.

In industry, the photographic department's function will gain even greater importance as the sales merchandising, manufacturing, publicity departments, etc. start clamoring for color. And as the demand grows the photographic department will also grow in size and stature.

For further information, speak to your photographic dealer, or write The FR Corporation, Professional Color Department E, 951 Brook Avenue, New York 51, N.Y.

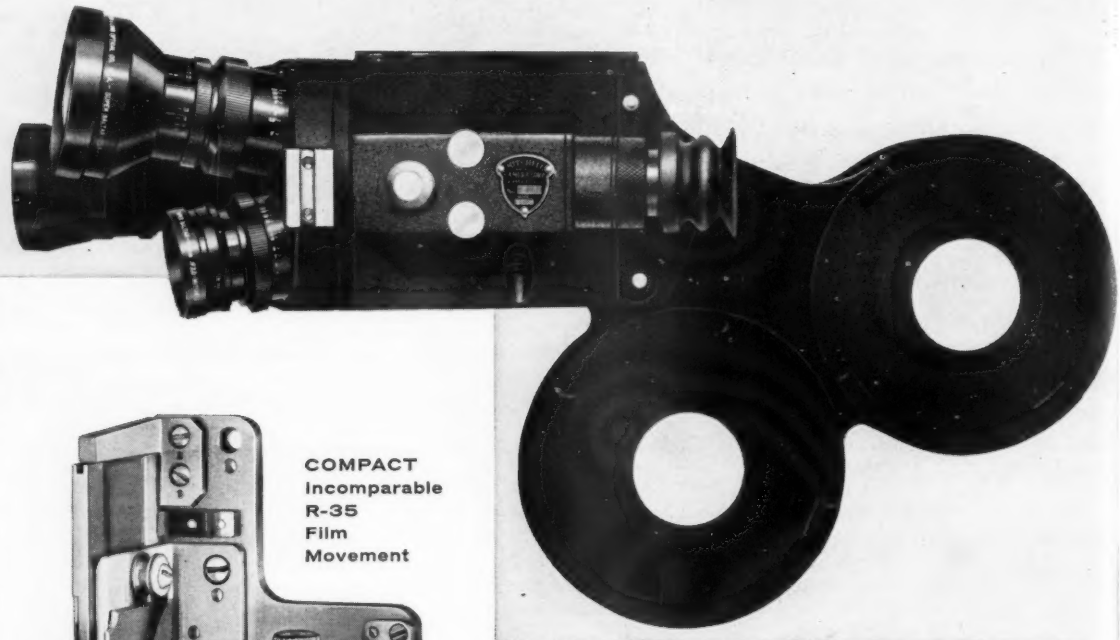
See FR Color demonstrated at the PPA Show in New York. Visit the FR Booth #204 and register to see an actual color demonstration. It will be the highlight of the show.

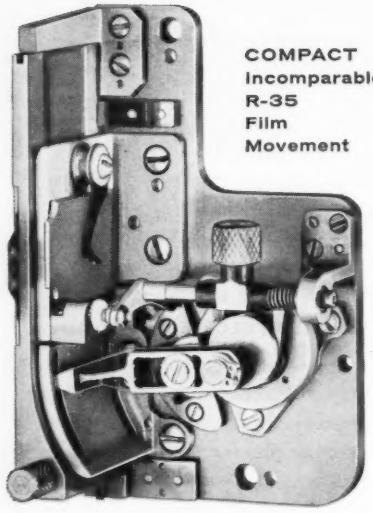
Get more information. Circle 500, page 77

NEW MITCHELL R-35

...only truly professional portable reflex motion picture camera

Designed to cover the widest range of professional motion picture applications, the all new Mitchell R-35 reflex camera offers remarkable versatility to exceed the requirements of most discriminating cinematographers. Streamlined design is combined for the first time with the full range of professional features by Mitchell—world's leading source of truly professional motion picture cameras and equipment.





COMPACT Incomparable R-35 Film Movement

Designed to produce rock-steady films completely compatible with those of the well-known Mitchell BNC, NC and Standard cameras, the new R-35 dual register pin movement features: Twin registration pins . . . twin pull-down claws; stop-motion to 120 F.P.S.; removable aperture plate with built-in filter holder slot . . . holds two thicknesses of gelatin filters. Full size: 0.980" x 0.735", removable pressure plate, entire movement removable for cleaning . . . special construction insures foolproof insertion with no loss of timing.

Hand Held or Tripod Mounted, the new Mitchell R-35 reflex camera uses a new series of Super Baltar matched lenses designed specifically for the R-35 by Bausch & Lomb. For Complete details of the outstanding features of this remarkable 35mm camera, write for the new R-35 Bulletin.

MITCHELL R-35

MITCHELL CAMERA CORPORATION
666 W. HARVARD ST., GLENDALE 4, CALIF.
TECHNICAL REPRESENTATIVE:
521 FIFTH AVE., NEW YORK 17, N. Y.

Get more information. Circle 468, page 77

AN EDITORIAL

LAST CHANCE

What is the proper role of the in-company photographer? In our view he should be the middleman between photography and his organization. His job is to find the common denominator between what photography can do in general, and what needs to be done specifically in his company. ■ From this vantage point, in-company photography becomes a much broader field than most people suppose. Producing an a-v program that will help a worker put a machine together, for example, making a photograph that will interest millions of customers in the machine and conducting a high-speed analysis that will enable designers to improve the machine all fall into the same category: they are photographic means which help a manufacturer do what he sets out to do, convert work and materials into revenue. ■ Wise photographers recognize that they are limited while their field is limitless. They realize that they can always learn from others faced with similar challenges. They make an effort to discover and utilize the ideas of others. Wise employers back them up. The result is a professional society. Two such societies deserve special mention at this time, because this is very nearly the last chance this year to take advantage of their most valuable opportunity. We refer to the Ninth National Industrial Photographic Conference of the Professional Photographers of America, which will be held at the Statler Hilton Hotel in New York City, July 30 to August 4, and Sixth Annual Technical Symposium and equipment exhibit of the Society of Photographic Instrumentation Engineers at the Ambassador Hotel in Los Angeles, August 7-11. The former is concerned with a wide array of photographic applications in industry, the latter specializes in the increasingly significant use of photography as a measuring tool. Both have proven they can distill into a week the results of experience which would require a man working alone years to acquire. ■ We urge management to bend every effort to see that at least one staff member attend each of these valuable meetings. A great number of organizations have been richly rewarded by past participation.

The Editors

Photo Department Analysis—Outboard Marine Corp.

The man in charge of research photography at the Outboard Marine Corporation of Milwaukee, Wis., is Daniel H. Lamb. He runs what might be called a photographic non-department.

Lamb's title is Senior Instrumentation Engineer. With the assistance of a full-time photographer he strives to make photography the everyday tool of every engineer in the Outboard Marine research laboratory. As much as possible the attempt is made to have the project engineer take his own pictures. Lamb and photographer Urban Bartel make the equipment available, furnish counsel, help in setting up the camera, lighting and any special optics, handle processing, and furnish projection equipment. But the watching, waiting, button pressing and data reduction is left to the project engineer. In effect, Lamb has succeeded in including everyone in the research laboratory in the photographic department, which was precisely his original aim.

Outboard Marine manufactures Evinrude, Johnson and Gale-Buccaneer outboard motors, Lawn-boy garden equipment, Cushman vehicles, Pioneer chain saws and Snow Boy snow blowers. Although the research laboratory has grown from four to eighty persons in the ten years of its existence, the integration of photography into research projects, along with efficient procedures, has enabled a solo photographer to continue to satisfy the everyday needs of the lab.

Furthermore, according to Lamb, photography has not only been the means to solution of innumerable specific instrumentation problems, it "has been a constant means of stimulating and exciting curiosity in the action of various phenomena relating to all of the Corporation's problems."

Lamb was graduated as a mechanical engineer from the University of Wisconsin. He got his photographic background at the Wright Aeronautical Flight Test Laboratory, where he became involved in high-speed photography and later supervised photographic work. He gained experience in another area of the photographic world by operating a portrait studio at the same time. His career with Outboard Marine began as research engineer. His present responsibilities include all forms of instrumentation, of which photography is an integral part.

Lamb feels that photo equipment is a valuable research tool as are voltmeters or oscilloscopes. He places special emphasis on the effectiveness of the high-speed camera because of its versatility. Not only has high-speed photography been used at Outboard Marine in routine problem solving, or to verify analytical solutions, but also as the only source of information on fast-moving events.

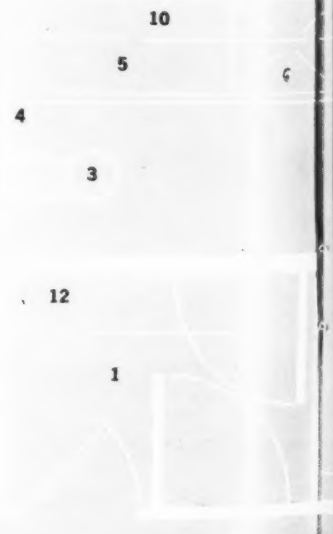
Outboard Marine uses a 16mm Wollensak Fastax camera for its high-speed motion picture work, with a speed control built in by the Company. For the most part, R750's are relied upon as light sources. Because prompt service is available, the film is reversal processed at local laboratories, unless the project is secret, in which case it is handled in the lab.

For qualitative study, the finished film is frequently spliced into a continuous look so that the project engineer can witness what goes on repeatedly without interrupting his concentration by rewinding the film and reloading the projector. This system has proven particularly valuable when two or more sequential events have been recorded separately. Bringing everything together without the bother of interruptions has aided engineers in their analysis.

Of course high-speed photography is not the only tool of Outboard Marine's photo instrumentation, but it has been the single most valuable one. The pictures illustrate some of the cases where it has provided otherwise inaccessible information.

While the project engineers are keeping the Fastax spinning, Bartel has plenty to keep himself busy with in the research laboratory and on field tests. His duties include small parts photographs for records and reports, record motion pictures, metallurgical photo-micrography, normal speed data recording including oscillography, processing of stills and oscillographic records, making slides for lectures and demonstrations, and preparing an occasional offset plate or two, with guidance and emergency assists from Lamb.

Bartel works in a small, but well-designed photo lab diagrammed below. The refinements include: A special wall-mounting for the enlarger which permits reductions on one hand, and practically ceiling-to-floor enlargements, on the other. A rotary washer built into the processing bench. Capacious closed storage above work areas and above head level in the light trap. The light trap is devised in such a way that it can be opened completely for moving equipment in or out of the room.—E. R. FARBER



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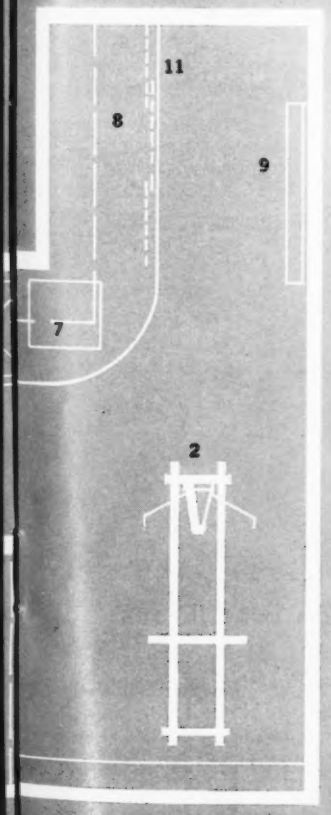
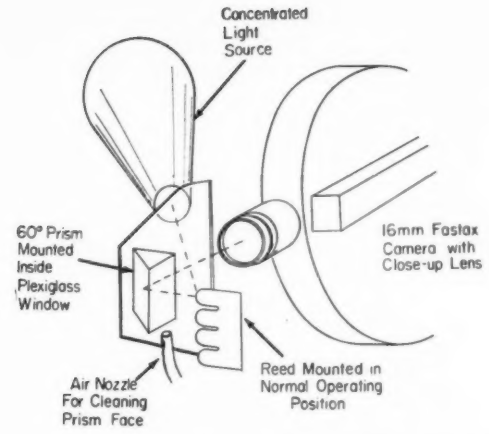
Milwaukee

EQUIPMENT & FACILITIES: SMALLISH—BUT VERSATILE

CAMERAS 4 x 5 Pacemaker Graphic, 8 x 10 Eastman View, Leica, Exakta, Bolex H-16, Wollensak WF 17 16mm high speed motion with 25, 35 and 50mm lenses. **ENLARGER** Omega D2 with constant voltage regulation and electronic timer. **PROJECTORS** 8mm De-Jur, 16mm Eastman silent, 35mm Bell & Howell sound, 35mm Bell & Howell slide, 16mm Craig editor. **LIGHTING EQUIPMENT** Graflite flash, Heiland Strobonar 72A, Sylvania Sun Gun, various flashguns and incandescent lighting units for RSP2, RFL2, R750, T20.

PHOTO LAB 1 Labyrinth light trap 2 Camera and copy stand 3 Enlarger 4 Constant voltage transformer 5 Developing area 6 Stainless steel sink 7 Built-in print washer 8 Finishing area 9 Wall rack for tripod and projection screen storage 10 Storage cabinet above work area 11 Storage below work area 12 Movie film storage



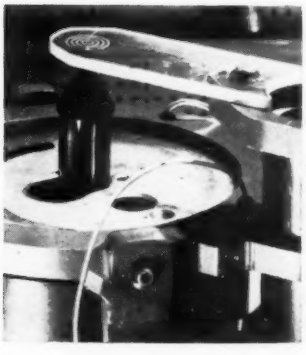

Concentrated Light Source
60° Prism Mounted Inside Plexiglass Window
16mm Fastax Camera with Close-up Lens
Air Nozzle For Cleaning Prism Face
Reed Mounted in Normal Operating Position

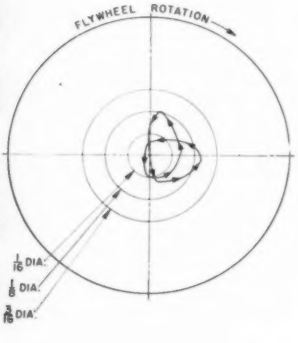
A DIAGRAM FOR UNMASKING THE TERRIBLE REED VALVE

Outboard motors use reed valves rather than the poppet valves used in automobile motors. These valves are very much like the reeds in a harmonica but details on their performance at high engine speeds was needed. Outboard Marine found the high-speed camera the ideal tool for their study but the valves are not ideal subjects. The diagram shows how this problem was solved. A prism permits a direct view by the camera into the valve under operating conditions. A plexiglass window protects the camera from the exhaust. During the picture-taking, the face of the prism is kept clear by scouring with an air nozzle. Valve is illuminated directly.

MOTOR DEFECTS: WHAT YOU CAN HEAR YOU CAN'T SEE

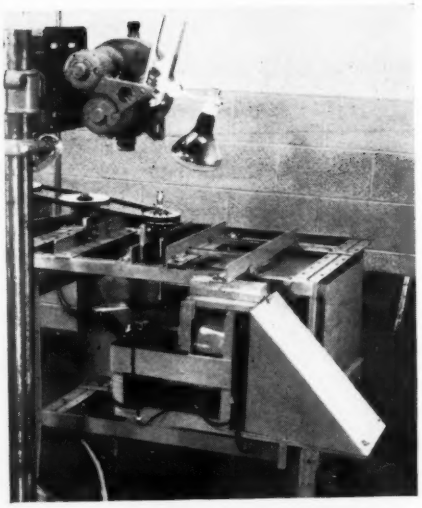
Outboard motors have quieted down considerably over the years. As a result, however, other noises have been unearthed. In one case, noise and vibration were most severe at certain speeds, apparently due to the flexibility of the crankcase and crankshaft. These parts were made under extremely high specifications and were considered to be very rigid. Careful study by high-speed cameras, however, showed that rigidity, at least in this case, was relative. To check the motor, a black cone with a white tip was placed on the end of the crankshaft of an outboard motor. A plexiglass grid was mounted above the tip to reveal this eccentric pattern.

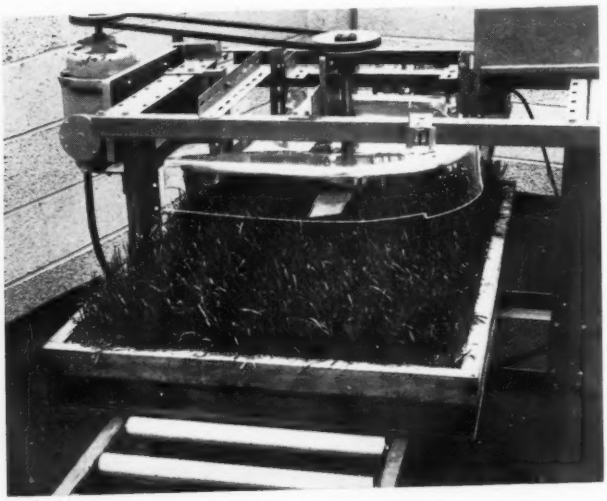


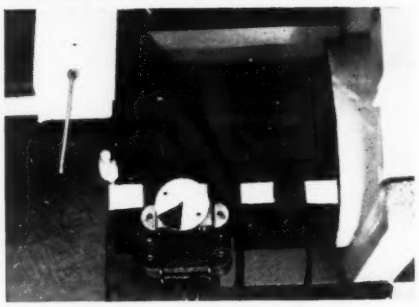


COMPUTERS AND CAMERAS TAKE KICK OUT OF MOWING

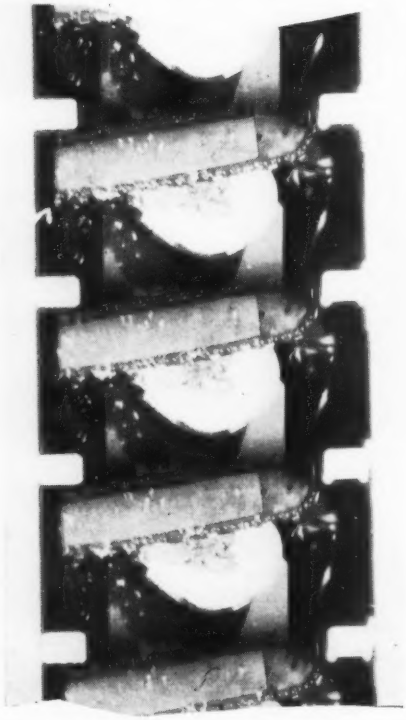
Rotary mowers work pretty smoothy until the blades hit a stone. When that happens, wham! The vibration can be felt for hours. The problem was to design a safety blade. The computer could do the design but its answers were checked by Fastax camera. A steel pellet was ejected into the path of the blade just when the camera reached speed. The smaller picture shows the camera, the blade and the synchronizing contact, plus the timer and the one-inch marks on the tape. Transparent housing (below) is used for other mower studies.

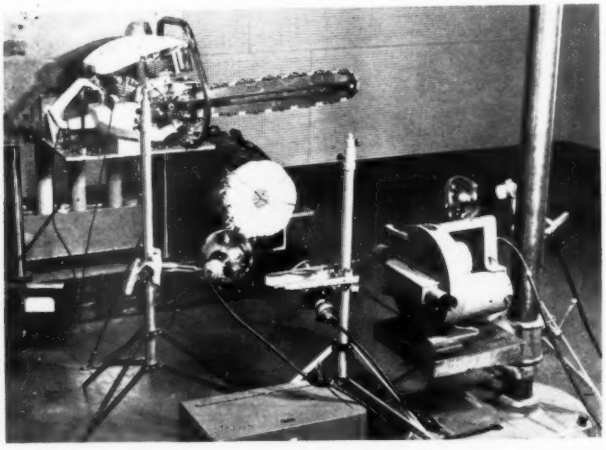






OUTBOARD MARINE (*continued*)





SEEING SAWING, HIGH-SPEED CAMERA EARNS ITS KEEP

This ingenious but simple method was devised to study the cutting action of a chain saw. A sheet of lucite, selected for its resistance to scratching, was attached to the end of a log. Then the saw was placed in position to cut the end of the log, just touching the lucite window. The result proved well-worthwhile. Tolerances in several cases could be relaxed.

MEMO ON:

COST RECOVERY

How can you get the people who use photo service to pay for it? The ways and means of recovering costs has become a fine art

Unless your section is carried as part of overhead, sooner or later, the problem of cost recovery will arise. This term, a management-type euphemism meaning "who can we get to pay for this service," implies a set of charges to be passed along to users. At this point, the question comes up: how much should be we charge?

The answer, we found, varies with the type of section and the budgetary system under which it operates. Small sections or those sections doing highly specialized work are almost always overhead and don't charge at all. At the end of an accounting period, they report on what they did, and how much it cost and the rest is up to management.

When sections get a little bigger, or when people start ordering photo service on general principles until the expense of the section is slightly overwhelming, a cost recovery plan is developed. A system of charges is established so that departments using photo service will know how much they will be billed. This not only discourages excess demands on the photo section but provides management with a rough yardstick of how much in-plant service costs compared to outside photography.

Charges vary

The amount and type of charge varies. In movie sections, for example, a labor charge may be made. In one section, photographers and directors are charged for at $7.50 to $10 an hour, based on time spent on the job. If the average labor charge is, say, $10 an hour, and a five-man section put in 7500 man-hours of work a year, the cost of photo service to using departments was $75,000. This figure should be fairly close to the cost of running the photo section for that year.

For still picture service, charges are generally listed by work done. These rates are within a narrow range and compare closely to costs of comparable work done by outside photographers. Developing and printing a roll of #120 film were $1.50, $1.50 and $1.25 in three photo sections queried. An 8 x 10 enlargement was $1.50, $1.25 and $1.50, respectively. A typical "custom" lab lists developing at $1.50 (including contact sheet) and 8 x 10's at $1.00. This shows how in-plant sections have to keep outside competition in mind when establishing a price list.

In a few cases, charges for photographer's services will be based on an hourly or daily labor charge. In one public relations section, this is based on the standard magazine rate of $125 a day, while in another section, it is $7.50 per hour.

Cheaper by the 3 dozen

Sometimes the charge per picture includes a pro-rated labor charge, the estimated time spent by the photographer taking the photograph, plus the cost of making the print, are added. One section using this system charges $2.75 per 8 x 10 picture including one print. Copy work for the firm's Art Department is $1.50 per copy. On traveling assignments, the charge per photographer is $28 a day plus expenses. Movie work is $5 an hour.

At times, when there is a great deal of quantity printing, the charge per print on large orders is smaller than for smaller orders. At one plant, 8 x 10 enlargements are 75¢ each; over 35 prints from one negative, this drops to 55¢ per print. The same price relationship holds for contact prints, charges being 50¢ and 35¢ respectively.

Occasionally, the charge may be on a job-bid basis. If one department has a project, the photo section may bid on the cost of the whole project. Usually, the bid will cover costs plus a slight margin for makeovers, delays, etc. In a very few cases, however, the in-plant photo bid will be just lower than an outside firm, regardless of cost.

Outside competition

Apart from the manager's pride in running an efficient, economical photo section, perhaps the chief control over prices charged is outside competition. Unless matters of security are involved or there is a question of convenience, many in-plant sections have to bid for company work against outside services.

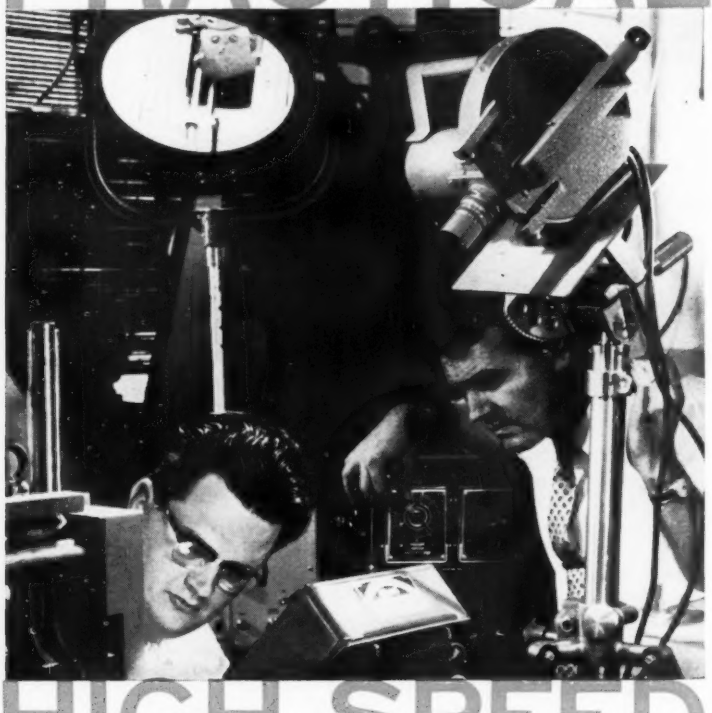
If costs are too high, leading to overcharging, the work will not be given to the in-plant section. Eventually, an in-plant section without work becomes a non-existent in-plant section.

Setting actual rates involves an accurate record of what was done for previous reporting periods plus a good guess at what will be done during the next reporting period. By dividing the workload into the estimated expenses, a reasonably good price list can be established. This list is revised from time to time as conditions change. A case in point is the increased use of small cameras by in-plant cameramen. A price schedule to cover roll film developing, contact proofing sheets and enlargements was added to the charge list. The former price for 8 x 10 prints, based on contact printing, was eliminated.

There is no pattern or universal system as far as cost recovery goes.

While prices are usually set to cover both labor and materials, there is one section, in a hospital, which supplies the photographer's services but charges for material. In a movie production unit, the salaries are charged as overhead while the actual production costs—photography, lab costs, printing, etc.—are charged against users of the section's films.—THE END

PRACTICAL HIGH SPEED



There's nothing magic about a high-speed camera. It's a tool, a practical device for solving real problems in science and industry. Whether it's practical for you depends on your capability, the problems you face, the costs, and your effectiveness in pressing your case. Here expert William G. Hyzer (shown working out a problem, above right) tells how to evaluate, and execute, high speed photography

Certainly the fastest growing field in technical photography today is high-speed motion pictures. Sooner or later every industrial photographer whose company is not actively engaged in the use of this technique is bound to ask himself, "Everyone else seems to be going to it. Why aren't we using high-speed photography?" If this question has crossed your mind and you weren't able to come up with the answer, this article was written for you. Actually there are nearly as many specific answers to this question as there are companies that don't use high-speed photography, but generally speaking, they might be categorized as follows:

1) Some industries are just not faced with the type of motion problems that lend themselves to solution by high-speed photography.

2) Being a relatively new and rapidly growing technique, managements in many companies are not aware of its possibilities nor have they analyzed what it might contribute to their field.

3) Some have been discouraged by unhappy past experience when techniques were crude by today's standards.

4) Others have dismissed it as a highly specialized technique, too costly for all but the larger corporations.

5) Many may feel that they do not have personnel qualified to operate a high-speed camera and could not benefit from the results obtained.

If your company has dismissed the consideration of high-speed photography for one or more of the above reasons (or if you have never realistically evaluated your company's status on the issue), perhaps now is a good time to look into the situation. Your company has nothing to lose, but plenty to gain from your efforts. You also will benefit by exposing yourself to new skills and broadening your experience into a new and rapidly expanding field. Use the suggestions outlined in this article as a guide in reaching a realistic decision as to whether or not you can use high-speed photography profitably in your company's business. With the help of this article, you should be able to come up with answers to the following pertinent questions: 1) Am I qualified to operate a high-speed camera effectively? 2) Is high-speed photography applicable to our line of business? 3) Can we

justify the expense of a high-speed camera and its related accessories? 4) If so, how do I go about selling my management on the idea? Let's answer each of these questions.

Who can do it?

Are you qualified to operate a high-speed camera? Actually, a high-speed camera is no more difficult to operate than a conventional camera. In typical practice, good pictorial quality might be defined as a recognizable image. The engineer wants data, not pretty pictures. If you have ordinary ability as a photographer, you can be taking high-speed movies within a couple of hours. If you have never pushed a button on any camera, more intensive effort will be required, perhaps several days. This isn't going to turn you into an expert, but you should be able to take pictures that will solve problems. The instruction book supplied by the manufacturer will provide you with all the basic information you need to get started. This can be supplemented with more detailed information derived from books, magazines and technical journals to deepen your knowledge of the subject. The vast majority of high-speed problems do not require elaborate set-ups, so a rather rudimentary knowledge of technical photography will see you over most of the rough spots. There are several excellent books on high-speed photography to help you when you get into a pinch. Table 1 lists some of the more popular books including a bibliography compiled by Elsie Garvin which contains practically every article written on the subject up to 1960. The bar graph on page 67 of the Jan. 1961 issue of PMI compares technical journals that devote editorial space to articles on high-speed photography.

Beginning at the beginning

At this stage perhaps we should define high-speed photography. What is it? In common terms, a motion picture is said to be "high-speed" when it was recorded at a framing rate exceeding about 150 frames per second. A film taken at 240 frames per second and projected at 24 frames per second serves to "magnify time" by a factor of ten. Most industrial problems fall within the range of 150 to 25,000 frames per second. Cameras are available in standard 8, 16 and 35mm sizes with film capacities ranging from 100 to 1000 ft. The 100-ft. capacity 16mm camera is by far the most popular industrial model, but don't start picking out your equipment at this point. First determine whether or not you have a need, then carefully define and analyze this need and finally, choose a camera that fits your requirements.

Picture frequency (in frames per second) for a 16mm camera is usually estimated on the basis of the following formula:

$$\text{Picture Frequency} = \frac{200 \times P \times \text{Subject Velocity (in./sec.)}}{\text{Field Width (in.)}} \quad (1)$$

P in the above equation is the shutter constant of the camera, equal to about 0.3 for the Fastax, Magnifax and Fairchild cameras. The shutter is variable in the Dynafax and Photo-sonics cameras. Analyze your potential applications in the light of the above formula to determine your picture frequency requirements. The same formula is expressed graphically on page 57 of the July 1960 issue of PMI.

High-speed pictures require lots of light. Photospots are most commonly used to illuminate small subject fields. Larger areas may require direct sunlight or more intense sources such as xenon arcs or flash bulbs fired in sequence. Exposure time per frame is given by the following formula:

$$\text{Time of exposure (sec.)} = \frac{P}{\text{Picture Frequency (frames/sec.)}} \quad (2)$$

For example, a Fastax operating at 5000 frames per second yields an exposure time (t) of $0.3/5000 = 1/17{,}000$ second, approximately. A chart for estimating the minimum amount of incandescent light required to illuminate various subject areas is shown on page 57 of the October 1960 issue of PMI.

TABLE 1 A SELECTED LIST OF SOURCES OF INFORMATION ON HIGH SPEED PHOTOGRAPHY

Flash! Seeing the Unseen by Ultra High-Speed Photography, H. E. Edgerton and J. R. Killian, Jr., Hale, Cushman and Flint, Boston, 1939
Action Photography, G. Denes Fountain Press, London, 1940
Photography in Engineering, C. H. Tupholme, Faber and Hyperion Ltd., London, 1945 ("High-Speed Photography," pp. 99-131)
Flash Photography, Gordon Parks, Franklin Watts, New York, 1947
Strobe, the Lively Light, H. Luray, Camera Craft, San Francisco, 1949
The Photographic Study of Rapid Events, W. D. Chesterman, Clarendon Press, Oxford, 1951
High-Speed Photography, its Principles and Applications, G. A. Jones, J. Wiley, N. Y., 1952
Photographic Motion Analysis, J. H. Waddell and J. W. Waddell, Industrial Laboratories Publ. Co., Chicago, Ill., 1955
High-Speed Photography, in 6 volumes, New York Society of Motion Picture and Television Eng., New York
Third International Congress on High-Speed Photography, Edited by R. B. Collins, Butterworths Sci. Publ. Ltd., London, 1957
Schlieren Photography, Eastman Kodak Company, 1960
Electronic Flash Photography, R. L. Aspden, Macmillan, New York, 1960
A Study of Splashes, A. M. Worthington, Longmans, New York, 1908
Fast Reactions in Solids, F. P. Bowden and A. D. Yoffe, Butterworths Sci. Publ. Ltd., London, 1958
A Further Handbook of Industrial Radiology, Edited by W. J. Wiltshire, E. Arnold, London, 1957, Chapter 12, "Flash Radiography"
Handbook of Photography, Henney, Dudley, New York, Whittlesey House, London, 1939, Chapter 26
Bibliography on High-Speed Photography, E. L. Garvin, Eastman Kodak Company, 1960
1961 Publications: **Engineering and Scientific High-Speed Photography,** W. G. Hyzer, Macmillan, New York
Instrumentation and High-Speed Photography, Vol. I Series 2, SMPTE

Where all the film goes

Commercially-available high-speed cameras use standard motion picture film. At high camera speeds it is important to use film that is fresh and is wound on dynamically balanced spools. A 100-ft roll of 16mm film contains 4000 frames. At 8000 frames per second, a roll of this film is consumed in about ½ second. The first 20 ft. or so is used up while the camera reaches operating speed. The last 80 ft. is used to record the event. The camera is synchronized with the event so the recording is made after the camera reaches speed, but before the end of the film is reached. The nomograph on page 68 of the November 1959 issue of PMI is helpful in estimating these times at various picture frequencies.

When you press the starting button on a 100-ft. model, there is no stopping it until the entire roll of film is consumed. One of the 16mm cameras of 400-ft. capacity may be required on long duration events or on actions that can not be anticipated within the "writing time" limits of the 100-ft. models. The 400-ft. cameras are available with provision for stop-start operation, so multiple runs may be made on the same 400-ft. roll of film. The large format 35mm cameras find application on problems where the improved resolution is deemed necessary. Fractional frame size cameras (half frame 35mm, quarter frame 16mm, etc.) yield a proportionately higher picture frequency for a given film velocity through the camera, but the ribbon-shaped format obtained with these cameras limits them to specialized problems.

If your applications are short duration and extremely high speed, you may find a drum-type camera (exampli-fied by the Dynafax) best fits your requirements.

What to look for in a camera

In any case, don't settle on a camera until you have thoroughly analyzed your anticipated applications, then make a list of your requirements as follows:

1) What maximum picture frequency do I really need? Equation (1) will help you to answer this question, once you know what the applications are.

2) What minimum picture frequency do I require? Again, Equation (1) will be found useful in combination with a study of similar applications found in the literature.

3) What frame capacity do I need? Take the product of event duration in seconds and picture frequency in frames per second. The answer comes out in approximate number of frames actually required to record the event. This is minimum frame capacity because film is consumed in bringing the camera up to speed and in synchronizing the camera with the event.

4) Is a full 16mm frame adequate for my needs or should I consider some other format?

5) What other unique requirements do I have, such as weight and size limitations, portability, battery operation, internal event synchronization features, variable shutter, etc?

The answers to questions 4) and 5) are dependent entirely upon your particular applications and can only be arrived at by careful study. Once you have pinpointed your requirements, compare them with actual camera specifications contained in Table 2. But remember, cameras with large frame size and capacities cost more to buy and will probably cost more to operate. If you can effectively use a 100-ft. capacity 16mm camera in your business, you stand to save substantially. Money, by the way, that you might prefer to use in purchasing accessories.

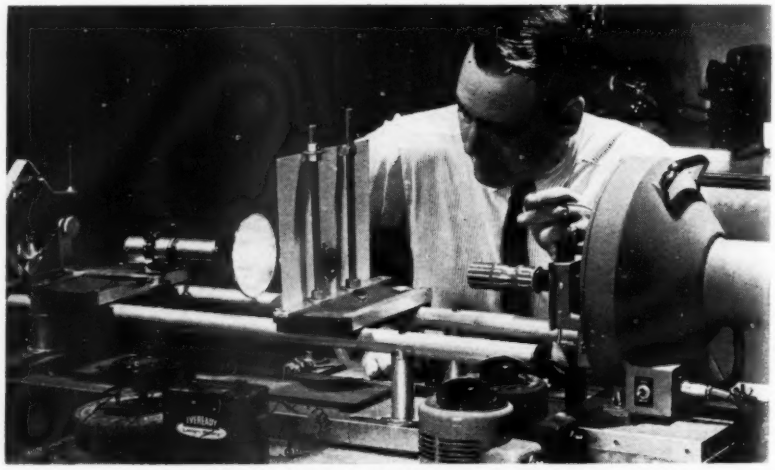
Accessories needed

While we're on the subject of accessories, what basic equipment besides a camera is required to photograph a typical high-speed subject? Let's answer this question by listing basic accessories along with their approximate costs:

1—heavy duty camera stand	$350
1—exposure meter	$15 to $200
(Price depends upon whether you want to modify a conventional meter or buy one designed for the job)	
4—clamp-on lamp sockets	$20—$35
4—photospots (RSP2, PH/750R)	$10—$22
2 to 4—lightstands	$15—$40
2—series-parallel switches	$25

A first project in high-speed cinematography:

CHECK OUT YOUR STILL CAMERA SHUTTER



The set-up: light source on rheostat, shutter, and high-speed camera

When you first acquire a camera, you will probably want to experiment on a rather straightforward-type of application. Perhaps you can find a simple problem in your own plant that is representative of those you will eventually face. If not, you might check out your technique by analyzing your own photographic gear—the between-the-lens shutter on your press camera, for example, makes a good subject. Simultaneously check its flash synchronization capabilities by including a flash bulb in the field of view. One advance word of caution, however, don't burn up a good lens and shutter by pouring too much incandescent light on it for an extended period. Put your lamps in series for alignment and focusing. Turn them on full brilliance only for brief periods to determine exposure and to photograph.

As a starter set the test shutter at 1/100 sec. Photograph its operation at about 2000 to 3000 frames per sec. Determine exposure with an exposure meter using the high-speed camera shutter speed provided by Equation (2). Use a fast film, such as Eastman Tri-X or Dupont 931. A conventional exposure meter can be readily modified for determining exposure at the high light levels involved. You can extend the meter range by taping a neutral density filter over the photocell, or alternately, since meter sensitivity is closely proportional to exposed photocell

Aside from these essentials, you may want additional lenses, extension tubes for close-up work, additional lighting facilities, special control equipment, etc.

Can it help you?

High-speed photography has applications in most industries, but those involved in the design, manufacture or operation of fast-moving machinery will use it most frequently. If your business is involved with motion occurring too fast for the eye to follow, you have a basic need for high-speed photography.

Here are some rules to follow in determining whether or not high-speed photography can be effectively applied to your company's operations:

Scan the literature (including books with chapters dealing with applications; use particularly the bibliography compiled by Miss Garvin) for references to applications in industries similar to yours. Obtain copies of pertinent articles. Start a file on the subject.

Discuss possible applications with production foremen, engineers and research workers. Share with them the information you have acquired on the subject. Get their ideas. Keep notes on these discussions for your file.

Discuss your problems with fellow workers in other companies and industries at conventions and society meetings. Attend lectures and symposia on the subject of high-speed photography when they are offered in your locality to get new ideas and answers to your questions. The University of Wisconsin Engineering Extension Division for example, holds an annual two-day short course on engineering photography that is highly informative.

Keep your eyes open for applications others might have missed. Remember, an engineer or foreman too close to a problem may not see the forest for the trees.

Once you have satisfied yourself that high-speed photography is applicable to your company's problems, the next step involves looking into the economics of the situation.

Is it worth it?

At this point shift gears and begin thinking in terms of cold cash. If you hope to sell management on the idea of buying a high-speed camera it helps to be able to express yourself in terms of dollars spent vs. dollars earned or saved. This is not a simple task, but the results of your efforts are put in a universal language that gets through to all levels of management. How do you arrive at these figures? Obviously, educated guesswork plays a mighty important role, so get some help from those in your company who are best equipped to understand

(continued on page 68)

area, extend the range by a factor of 10 by masking off 9/10ths of the window covering the photocell. If you prefer to use a neutral density, choose one having a density of one to increase the meter's range by a convenient factor of 10. Incident light readings in typical high-speed cinematographic practice range between 1000, and 100,000 foot-candles. At extremely short exposures, some loss in film sensitivity is evident as a result of reciprocity law failure, but ordinarily the wide exposure latitude of modern-day emulsions practically eliminates the effects of this phenomenon. Color films will exhibit a slight color shift due to reciprocity law failure, but seldom is exact color rendition critical in engineering applications. Color is normally used to emphasize chromatic contrasts in the subject that do not show up clearly as brightness differences on black-and-white film. It can be effectively applied to both mechanical and self-luminous subjects.

When you get your films back from the processor, you will want to project them first in a standard motion picture projector to obtain a qualitative visualization of event performance. In the case of a camera shutter, you can observe how the blades open and close. Also, you will be able to see if the flash bulb reaches full luminosity while the shutter is fully open. You can perform a quantitative analysis by measuring the progress of the action frame by frames the test shutter is open, divide this by the picture frequency (in frames per sec.) used to record the action and obtain shutter speed in seconds. Exact picture frequency is determined by counting timing marks exposed along the edge of the film. These marks are exposed on the film as it passes over a flashing glow lamp in the camera. The timing lamp may be excited 120 times a second by ordinary 6-cycle current, or to greater accuracy, by a timing lamp generator, which is nothing more than a precisely controlled oscillator.

A series of pictures, part of which is shown here, were taken at 4000 frames per second. It shows the action of a shutter at 0.25 millisecond (1/400 sec.) intervals. Twenty-one frames or 21 x 0.25 = 5.25 milliseconds are required for the shutter to open; 18 frames or 4.50 milliseconds to close; and it remains fully open for 9 frames or 2.25 milliseconds. Total open time is 5.25 + 4.50 + 2.25 = 12.00 milliseconds. This is about 1/85th of a sec.

The efficiency of a shutter is given by the following equation:

$$E = \frac{t_f + \frac{1}{2}t_o + \frac{1}{2}t_c}{T} \times 100$$

where E is efficiency, percent; t_f is time shutter is fully open; t_o is time required for shutter to open; t_c is time required for shutter to close; and T is total time shutter is open. Using the data above:

$$E = \frac{2.25 + \frac{5.25}{2} + \frac{4.50}{2}}{12.00} \times 100 = 59.4\%$$

Effective shutter speed is 59.4 percent of 12 milliseconds or 7.13 milliseconds (1/140 sec.).

HIGH-SPEED FRAMING CAMERAS

Camera	Speed, frames per sec.	Frame Size	Film Capacity	FRAMING PRINCIPLE: IMAGE DISSECTION	ROTARY PRISM	ROTARY MIRROR	INTER-MITTENT	SYNCHRONIZED REPETETIVE FLASH	DRUM CAMERA	STOP-START OPERATION	COMBINED OSCILLOGRAPHIC RECORDING	Price*
BECKMAN & WHITLEY												
Magnifax	1000 – 3200	standard 16mm	100 ft.		✓							$1713
Dynafax	up to 25,600	standard 16mm in two rows on 35mm film	2.8 ft. (224 frames)			✓			✓			4950
BENSON-LEHNER CORP.												
HS-16B	100 – 400	standard 16mm or double 16mm	200 ft.				✓					2600
FAIRCHILD CAMERA & INSTRUMENT CORP.												
HS 100**	16 – 2200 (depending on motor)	standard 16mm	100 ft.		✓							1330
HS 101	16 – 8000 (depending on motor)	standard 16mm	100 ft.		✓							1395
HS 108	32 – 16,000	half 16mm or standard 8mm	100 ft.		✓							1895
HS 116	64 – 32,000	quarter 16mm	100 ft.		✓							4975
HS 401	25 – 6000	standard 16mm	400 ft.		✓					✓		2670
HS 408	50 – 16,000	half 16mm or standard 8mm	400 ft.		✓							3170
HS 416	100 – 32,000	quarter 16mm	400 ft.		✓							6005
FRANK FRUNGEL												
Strobodrum and Strobokin Flasher	(1) depends on flashing rate and desired frame height (2) maximum speed is 50,000 frames per sec.	24mm width (height depends on flash rate)	5 ft.					✓	✓			16,000
PHOTO-SONICS INC.												
16mm-1A	300	standard 16mm	100 ft.				✓					7000
16mm-1B	12 – 1000	standard 16mm	1200 ft.		✓							1300
16mm-1C	to 4000	standard 16mm	400 ft.		✓							5500
35mm-4B	250 – 2800	standard 35mm	1000 ft.		✓							7400
70mm-1A	100 – 400	.218 x 2.218 in.	80 ft.				✓					6000
70mm-1B	100 – 400	.218 x 2.218 in.	1000 ft.		✓							8000
WOLLENSAK OPTICAL CO.												
Fastaire Fa-16**	12 – 680 (depending on motor)	standard 16mm	50 ft. 100 ft. 200 ft.		✓							1295
Fastax WF1	300 – 16,000	half 16mm or standard 8mm	100 ft.		✓							1795
Fastax WF2	700 – 18,000	half 16mm or standard 8mm	400 ft.		✓							3000
Fastax WF3	150 – 8000	standard 16mm	100 ft.		✓							1795
Fastax WF3T	150 – 6000	standard 16mm	100 ft.		✓							—
Fastax WF4	350 – 9000	standard 16mm	400 ft.		✓							3000

* Prices are approximate only. ** Airborne Model.

HIGH-SPEED FRAMING CAMERAS

Camera	Speed, frames per sec.	Frame Size	Film Capacity	FRAMING PRINCIPLE: IMAGE DISSECTION	ROTARY PRISM	ROTARY MIRROR	INTER-MITTENT	SYNCHRONIZED REPETETIVE FLASH	DRUM CAMERA	STOP-START OPERATION	COMBINED OSCILLOGRAPHIC RECORDING	Price
WOLLENSAK OPTICAL CO. (continued)												
Fastax WF4S	350 — 9000	standard 16mm	400 ft.		✓					✓		—
Fastax WF5	100 — 6000	half 35mm	100 ft.		✓							2850
Fastax WF8	200 — 2500	standard 35mm	500 ft.		✓						✓	8500
Fastax WF9	100 — 6000	half 35mm	100 ft.		✓						✓	3000
Fastax WF14	650 — 8000	standard 16mm	400 ft.		✓						✓	3750
Fastax WF15	1300 — 16,000	half 16mm or standard 8mm	400 ft.		✓						✓	3750
Fastax WF17	150 — 8000	standard 16mm	100 ft.		✓						✓	2250
Fastax WF21	300 — 16,000	half 16mm or standard 8mm	100 ft.		✓						✓	2250
VINTEN												
HS-300	100 — 300	standard 35mm	400 ft.				✓					—
ERCONA CORPORATION												
Zeiss Ikon ZL1	250 — 2000 500 — 4000	18 x 22mm 9 x 22mm	150 ft.			✓						21,500
L. C. EICHNER INSTRUMENTS												
	200 — 1600	standard 16mm or 35mm film widths	40 ft.					✓		✓		—
ACMADE HIGH-SPEED CAMERA												
	100 — 2000 200 — 4000	standard 35mm half 35mm	200 ft.		✓							—
J. LANGHAM THOMPSON LTD.												
Courtney-Pratt Series 600	1000 — 150,000	87 x 112mm	Exposure is on a single 4x5 in. plate (300 frames)	✓								5000
J. H. WADDELL INC.												
Model 16-1-A to 16-1-C	3 — 2500 depending on gear box and motor	standard 16mm	100 or 400 ft.		✓							1775
Model 16-2	200 — 6600	standard 16mm	100 or 400 ft.		✓							1850
Model 16-3	300 — 10,000	standard 16mm	100 or 400 ft.		✓							1850
HITACHI, LTD.												
Type 16H	500 — 10,000	standard 16mm	100 ft.		✓							—

DEFINITION OF HIGH-SPEED CAMERA SYSTEMS
High-speed cameras operate on several different principles. With the exception of the intermittent camera, the film flows past the lens in one continuous motion or, as in the case of ultra-high speed cameras (not included on this list) and image dissection cameras, the film remains stationary and the image is transferred to it optically.

INTERMITTENT CAMERA Conventional-type motion picture camera used at speeds up to 400 frames per second.

ROTARY PRISM CAMERA Film flows through camera continuously while image is "wiped on" the film by a prism located between the lens and the film and rotating in synchronism with the film.

ROTARY MIRROR CAMERA Similar in design to rotary prism camera except a mirror is used in place of a glass prism.

SYNCHRONIZED REPETETIVE FLASH Film flows continuously past the open lens of the camera in synchronism with a pulsed short-duration flash which exposes each successive frame as it moves into position behind the lens.

DRUM CAMERA Film is formed in a continuous loop, usually inside of a drum, which is rotated at high speed to move the film past the lens.

IMAGE DISSECTION CAMERA The image on one plate is broken up into a symmetrical array of minute elements or dots so that a series of independent pictures may be recorded on the same plate. The images are unscrambled by the same optical device used to record them.

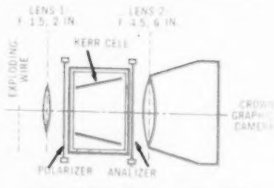
HYPER SPEED STILLS

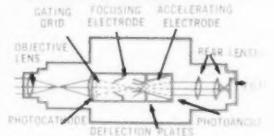
Photography began cutting its teeth on the problems of science in the late 19th century when it became clear that the camera could record things that eluded the human nervous system. Among the mechanical marvel's attributes was its speed. It was actually faster than even the quickest glance and more accurate by a long shot. Present-day equipment, however, has gone a good many stages beyond the early attempts at high-speed shuttering. It is so fast that it is no longer possible for the ordinary man to imagine the thinness of the slices it makes in time. One of the units of measurement, indeed, is not even in the ordinary dictionary; it is a recent coinage for a newly-recorded time domain.

The equipment described below and on the following pages comprises commercially-available equipment of domestic manufacture for making a single exposure. The list makes no pretense at being exhaustive, but it is an attempt to single out the means of making the very shortest photographic exposures with one-shot cameras. It does not include the rare motion picture equipment that does operate in these very brief time domains.

The finer limits of brevity for the apparatus described reaches into the nanosecond range. A nanosecond is a billionth of a second. For our English friends, an American billionth is a thousandth of a thousandth of a thousandth of a second.

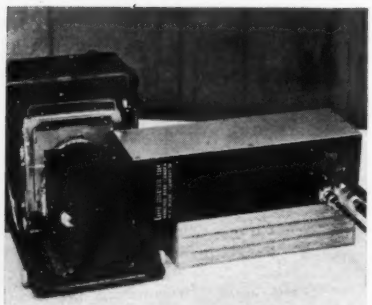
Aside from curiosity, why should anyone want to know what goes on in a billionth of a second? The answer is like Hillary's motive for his ascent of Everest: because it was there. Things do happen in the briefest of time spans and in some cases these are crucially important happenings. To know what they are is half the battle in knowing how to control them. A most important application of very high-speed photography is explosions for military and peaceful purposes. Another is the behavior of electrical charges, in tiny sparks or massive lightning bolts. The interaction of air and other fliuds with high-velocity objects, including bullets and nose cones, is still another. Wherever the blur of motion obscures the facts, quicker means of photorecording will be required and, likely, provided. *(continued on page 84)*





How They Work: Kerr Cell (above) and Image Converter

KAPPA SCIENTIFIC CORPORATION
49D S. Baldwin Ave., Sierra Madre, Calif.



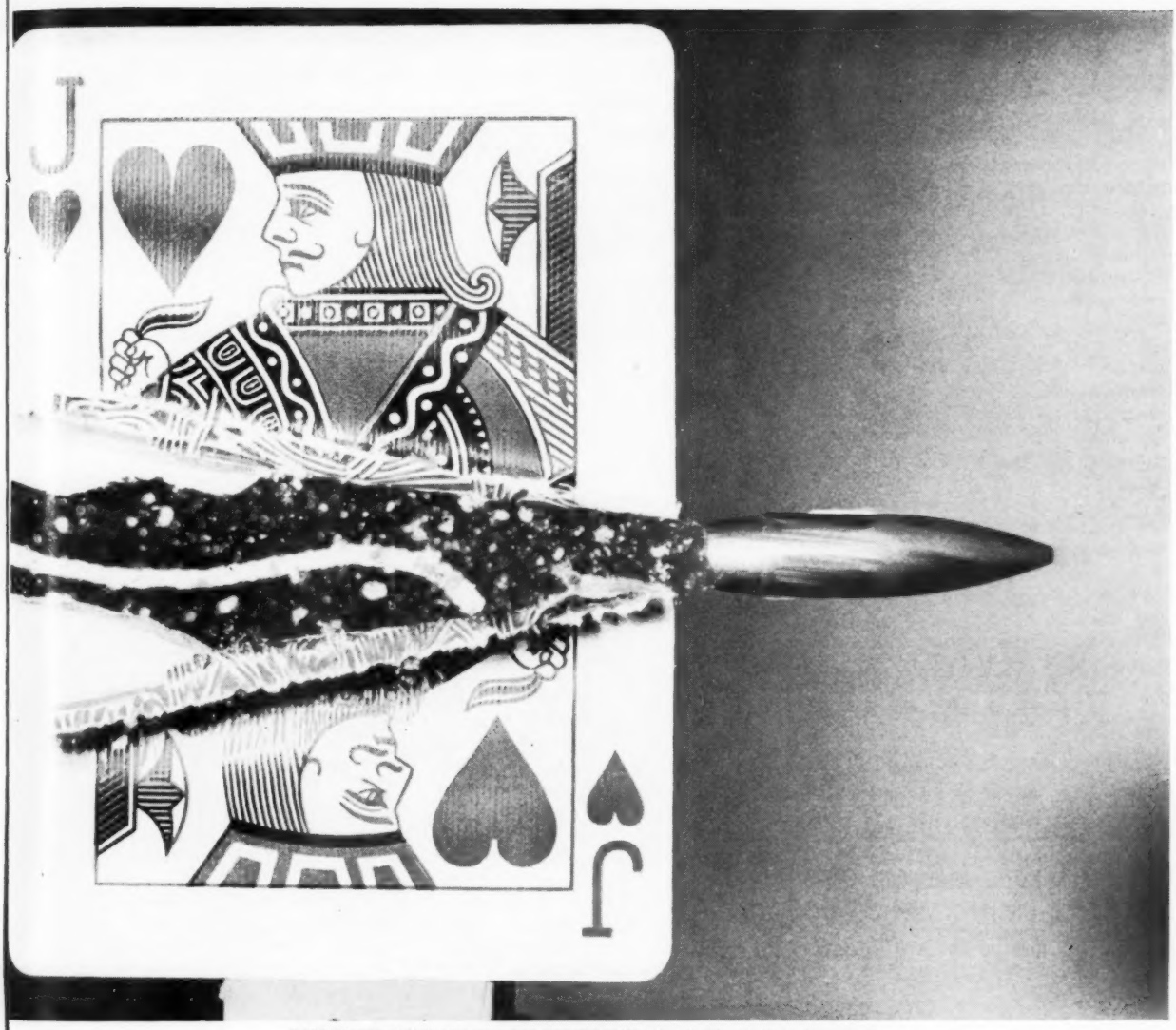
Kappa Scientific Corp. Kerr Cell System

■ Model 1131 Kerr Cell Camera, $5,906.95. A system evolved from the 5 nanosecond Kerr Shutter developed for the Picatinny Arsenal in 1957. It has an exposure time range of 5 nanoseconds to 1 microsecond. Employs a Kerr Shutter that uses a two-electrode, hermetically sealed Kerr Cell with integral expansion chamber. Chemically pure nitrobenzine is used as the electro-optical medium and the spectral absorption edge is about 430 millimicrons.

Optical aperture (small end) is .8 x 1.5 inches. Optical transmission: HN-32 Polaroid filters, open—.2, closed—10^{-5}; HN-22, open—.1, closed—10^{-6}.

A high-voltage, brief duration pulse generator using hydrogen thyratron in a low inductance configuration is said to operate the Kerr Shutter with an "essentially zero" jitter. Shuttering amplitude is 35 kilovolts.

The High Voltage Power Supply is a selenium rectifier type, hermetically sealed. Output connection is made by shield-grounded coaxial cable. Input power is 115 Volts, 60 cycles; output voltage, 0 to 40 kilovolts; output current, 2 milliamperes.



EG&G Microflash Unit records a new way of "cutting the deck" at half a microsecond

The Pacemaker model C93 Crown Graphic camera is furnished as standard equipment. Its Graflok back accepts all Graphic film attachments enabling use of over 40 different types of film. Solenoid synchronization permits remote control operation of shutter.

Research applications include plasma investigations, high velocity tunnels and particles, and explosives and ballistics.

ELECTRO-OPTICAL INSTRUMENTS, INC.
2612 E. Foothill Blvd., Pasadena, Calif.

■ KSC-51/A Kerr Cell Camera, $6625. Exposure time range of 5 nanoseconds to 10 microseconds. It is comprised of a Kerr Cell Shutter, a milli-microsecond modulator, a high voltage power supply and a Crown Graphic 45 camera.

The Kerr cell is hermetically sealed and has a resolution of 1:10,000. The modulator furnishes operating power, controls the high voltage power supply and allows adjustment of the hydrogen thyratron pressure for optimum pulse generating.

The unit features a low voltage pulse generator.

Optical aperture (small end) is .8 x 1.5 inches. Optical transmission: HN-32 Polaroid Filters, open —.25, closed—10^{-5} to 10^{-4}; HN-22, open—.12, closed—10^{-6} to 10^{-5}.

Its applications include plasma physics, hypervelocity particle trajectory and impact studies, and transient aerodynamics.

■ KSC-51/B Kerr Cell Camera, $7975. Consists of the KSC-51/A model combined with a Synchronizing Pulse Generator to initiate the Kerr Cell shuttering action, reducing the delay to the order of 50 nanoseconds and the jitter to below 1 nanosecond. Applicable where extreme precision in the shuttering action is required, as in spark gap

HYPERSPEED STILLS *(continued)*

breakdown phenomena, electrically exploded wires and single crystal explosives.

■ KSC-20 Kerr Cell Camera System, $4795. Useful for studies involving only moderate exposure time requirements. It has an exposure time range of 20 nanoseconds to 10 microseconds, a shuttering pulse amplitude of 25 kilovolts. Optical aperture is .5 x 1 inch. Transmission characteristics are the same as in the KSC-51 line.

■ KSC-10 System, $5775. Exposure time range of .1 to .2 microsecond. Applicable for the study of self-luminous phenomena such as combustion, electrical charges and arc formation. For non-self-luminous subjects, synchronized flash lamps can be used.

■ KSC-51 System, $6285. Identical to the KSC-51/A, but does not contain an integral low voltage pulser.

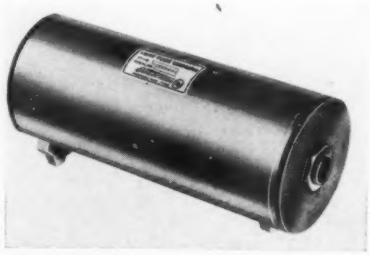
■ KSC-50 System, $7975. Electrical and optical performance similar to the KSC-51/A. Applicable where the operation of accessory instrumentation is not required.

■ Kerr Cell Shutter Units. Components of the above systems are available separately at prices ranging from $875 to $1650.

UNIELECTRON INC., 227 Binney Street, Cambridge 42, Massachusetts

■ Nanosecond Kerr Cell Shutter System, $6622. Exposures from 5 nanoseconds to .1 microsecond, The system's components, available separately, are a Type NKS-021 Kerr Cell Shutter ($5480), a Type 0-60 High Voltage Power Supply ($932) and a Trigger Generator, TG-050 ($210).

■ Light Pulse Generator, $1883. Provides a high intensity point source of light with a duration as short as .3 microsecond. It features



Unielectron, Inc., Light Pulse Generator

a Plug-in Trigger Input Transformer which allows direct coupling to the trigger electrode for special low jitter systems; a Synchronized Pulse Output that provides for accurate synchronization of an external device (such as a chronograph) with the spark discharge that produces the photograph; and a Guided Spark Discharge that is said to provide an intense, non-wavering point source of light.

The unit is cylindrical with a coaxial capacitor serving as the energy storage device. Case size is 12½ inches long by 5 inches diameter. Weight is about 9 lbs.

Applications include schlieren and shadowgraph systems, carrier life testing of photosensitive semiconductors, ballistics range photography and similar events requiring an ultra-high-speed flash source.

A nanosecond light pulse or photograph of hypersonic and/or luminous events can be provided by coupling the Light Pulse Generator with the Nanosecond Kerr Cell Shutter by means of the Type KS-060 Light Pulse-Kerr Cell Synchronizer. Price for this accessory is $490.

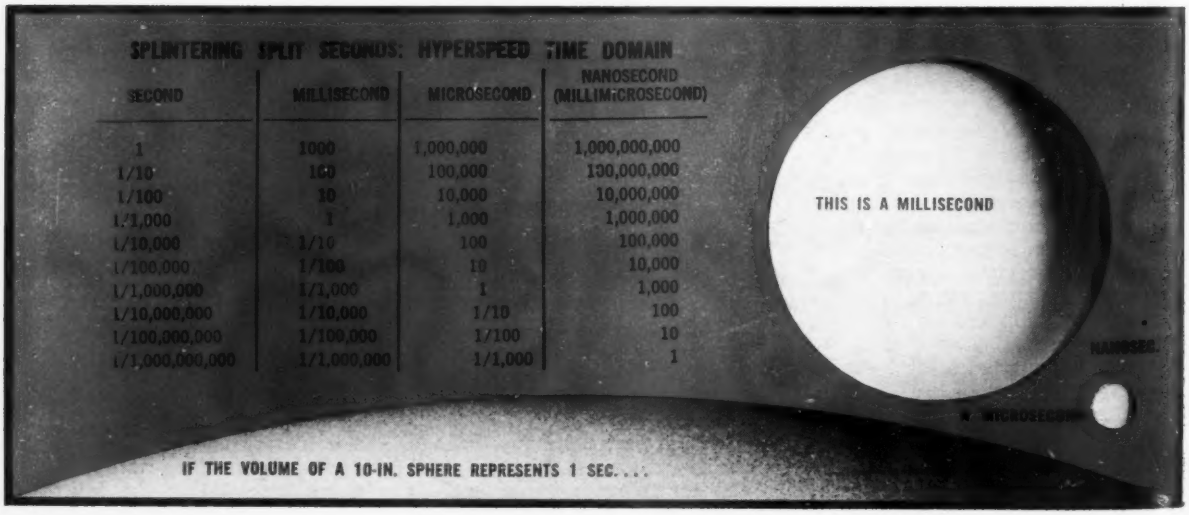
EDGERTON, GERMESHAUSEN & GRIER, INC., 160 Brookline Ave., Boston 15, Mass

■ Xenon-filled Electronic Flash Tubes. Feature a cylindrical lighted volume of 1.2mm diameter and 6mm length for use as a small source in optical systems such as the schlieren and interferometer types. Flash duration varies from 0.3 to 3.0 microseconds depending on the circuit conditions. Prices range from $15 to $117.

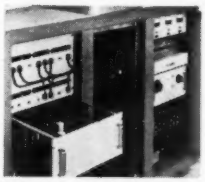
■ Type 2307 Double Flash Light Source, $2000. Measures the velocities and patterns of air-shock waves produced by explosives or the speeds of objects moving up to 8000 ft. per sec. It flashes at accurate intervals from 5 to 100 microseconds with a duration of 1/3 microsecond. It triggers photoelectrically, electrically, manually or by sound waves. Power input is 115 Volts, 60 cycles; size is 13 x 8½ x 28 inches.

■ Type 2208 Rapatronic Camera, $3000. With an exposure time of 1 microsecond, it is designed to produce photographs of fast, transient phenomena such as brilliant high explosives. It consists of a magneto-optic shutter assembly, a 4 x 5 Graphic II View Camera and a power supply. Shutter triggering

(continued on page 84)

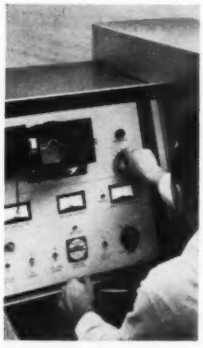


Electronic Instrument Gives Precision Readout of Photo Quality

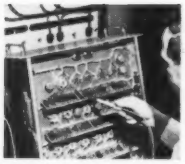


Compartmentalized Access

Direct Reading



Photographic Record



Easy Circuit Testing

The new Houston Fearless electronic *Image Quality Meter* accurately measures granularity, acutance and resolution of black and white photographic transparencies rapidly and automatically. Accommodates cut and roll film up to 18″ wide.

Basic Evaluation Tool – The Image Quality Meter permits holding standards for controlled performance of all photographic systems – as basic to the photographic instrumentation field as the oscilloscope is to electronics. The most intricate systems can then be tested and evaluated precisely to the rigid standards established by this instrument.

How it Works – The film image is scanned with a moving spot of light; the light is collected in a photomultiplier tube and the input signal variations are then measured electronically with an analog computer. Results are observed on three meters (acutance, granularity, resolution). The microdensitometer trace on the oscilloscope may be photographically recorded at operator's option.

Carefully Engineered – Heavy duty circuitry is designed for easy access and quick testing. A massive steel frame immobilizes the optical system, fixing it permanently against mis-alignment due to shock and vibration. Console is on casters for easy movement about laboratory.

Write for Specifications – Orders are being accepted for early delivery. Write now for complete information on this remarkable new photographic instrument.

WESTWOOD DIVISION HF HOUSTON FEARLESS CORPORATION, LOS ANGELES 64, CALIF.

Get more information. Circle 448, page 77

Drafting simplified by photography

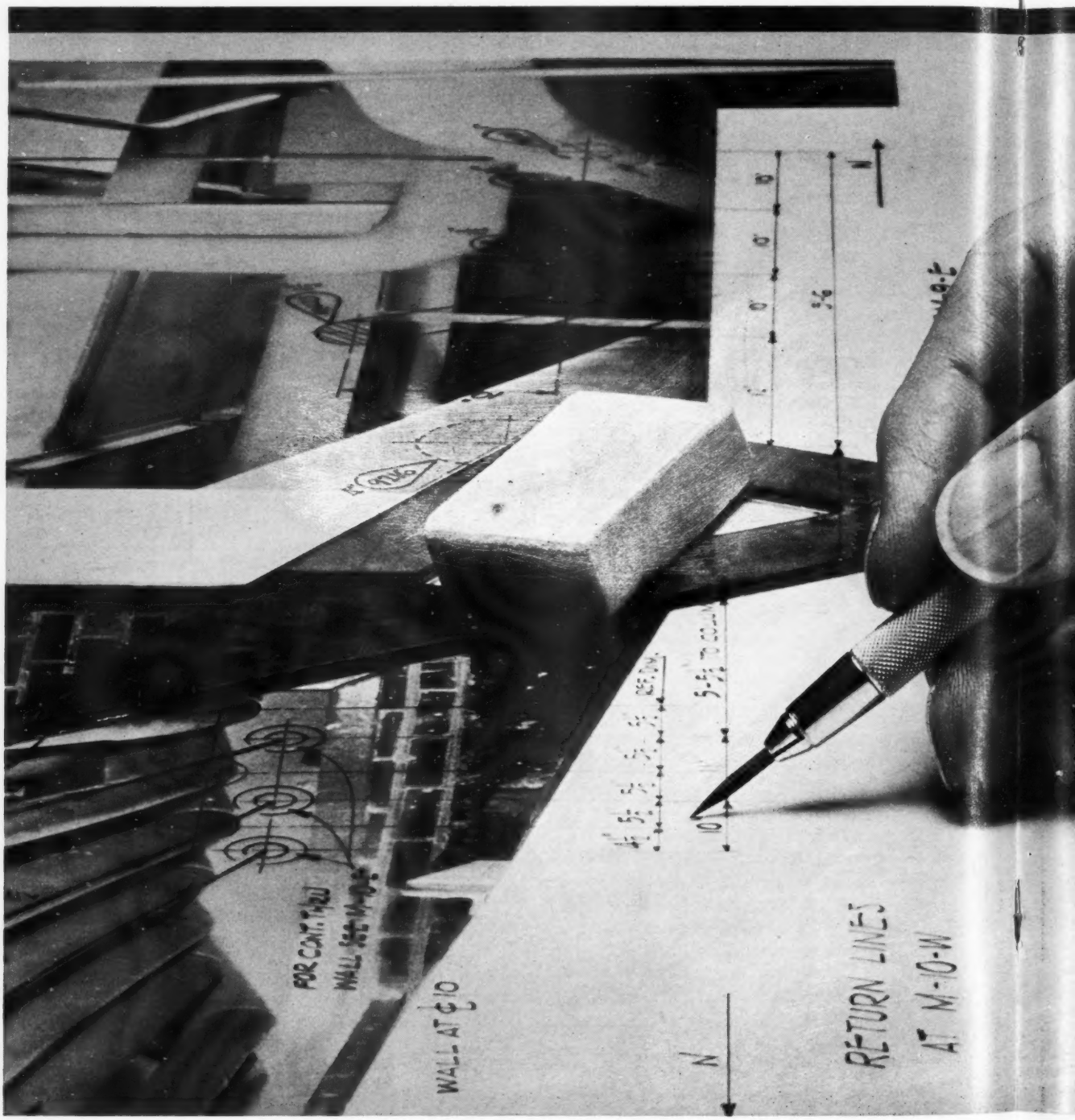
You'll recognize this picture as a "photodrawing" to which a draftsman is adding modification symbols. This application of "photodrawings" in making plant or equipment modifications can save engineers and draftsmen time and cost. In addition the picture imparts a clearer understanding of the modification to personnel performing the work.

Here's how four Du Pont photo products are used to make a "photodrawing":

CRONAR® Press or High Speed Pan is used to photograph the subject which forms the photographic element of the "photodrawing." This could be a plumbing line, piece of machinery, electrical equipment—whatever it is that requires modification.

A glossy print from the negative is made on VARIGAM® Paper.

From the print a halftone negative is made on CRONAR Ortho A Litho Film.



The halftone negative is stripped into position on a negative format—also made on CRONAR Ortho A—and contact printed to CRONAFLEX Contact Film.

Result: a "photodrawing" ready for drafting.

The development of outstanding products and unique applications is a continuing one at Du Pont. Our job is to make sure that you get the best films and papers to make your job most productive.

E. I. du Pont de Nemours & Co. (Inc.)
Photo Products Department
Wilmington 98, Delaware
In Canada: Du Pont of Canada Limited, Toronto

DU PONT

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

NON-TOPOGRAPHIC PHOTOGRAMMETRY

Photos: Allen Discus, Chicago Aerial Survey. Product photos: Wild Heerbrugg, Galileo Santoni

A prototype of a new appliance part is photographed and the picture plotted to supply numerical coordinates which can then be fed into a computer to control an automated assembly line.

A newly-admitted college freshman is photographed to measure the degree of posture defects and to plan any necessary remedial action.

The efficiency of combustion in a blast furnace is measured by placing a camera inside the 1900 deg. C. fire box and photographing the flame and the smoke.

A man buying a suit is photographed in a clothing store from all sides. The store will use measurements from these pictures to help provide a better fit.

Airmen are photographed and measurements taken from the photographs to provide data for design of control spaces and intrument panels, suitable for most flight personnel.

These are just a few current applications of photogrammetry to non-topographic requirements. In these cases, the basic reasons for using photogrammetric methods exist: the need for accurate data when time or environment make direct measurement impossible or impractical.

Defined by the American Society of Photogrammetry as "The art or science of obtaining reliable measurements by means of photography," its traditional role was in mapping, either from ground cameras or, more commonly, from

LONG ASSOCIATED SOLELY WITH AERIAL MAP-MAKING, PHOTOGRAMMETRY IN A COMPUTER AGE HAS NARROWER HORIZONS, WIDER OUTLOOK

aerial cameras. The identification of photogrammetry with aerial surveying has become so well-known that many dictionaries define the word in topographic terms.

Long, long ago

Actually, the use of the camera in mapping antedated the airplane by about fifty years. The "Father of Photogrammetry," Captain Aime Laussedat, earned his title in 1852 after making a survey of a village near Paris using collodion wet plates. Even before photography, however, engineers were using the *camera oscura* to aid in mapping, tracing the image projected on the ground glass.

In recent years, however, applications to non-topographic requirements have developed to the point where Gomer T. McNeil of Photogrammetry, Inc., could predict that ". . . the national gross product in the United States of specialized applications and measurements will exceed that of aerial topographic mapping within the next generation."

To draw a distinction between the two areas, the unwieldly, though unambiguous term "non-topographic photogrammetry" was coined to cover non-aerial, non-survey uses. While some photogrammetrists disagree with the term on the grounds that all photographic measurement is photogrammetry, the longer phrase will be used in this discussion.

It seems so simple

What is photogrammetry? Briefly, it involves taking a picture (usually a stereo pair) of an object, placing the picture in correct perspective and examining it to obtain information. This information may be qualitative (as a series of contour lines) or quantitative (numerical values). In all non-topographic work, it is the latter which is desired. For example, what is the degree of combustion at various fuel and air mixtures? How high must a dial in a cockpit be so that the average pilot may see it most easily? How deep is the countersinking for this mounting rivet? The accuracy of these answers depends upon the precision with which the instruments are made and the skill of the operator. The basic concept, to take a picture and measure it, is quite simple. To attain the result is extremely difficult and painstaking.

There are three basic steps in the photogrammetric process: taking the picture, rectification (eliminating distortion) and plotting (getting the information). Great care and skill must be used in each step lest an error at one stage negate

the work of the other two stages.

Cameras used in non-topographic photogrammetry may be either modified aerial cameras or specially-designed models, depending upon the requirements of a particular object.

The first modification in adapted aerial cameras for non-topographic work is the ability to use glass plates rather than film. Plates are preferred because of greater dimensional stability despite changes of humidity and temperature. Their humidity coefficient is nil and the thermal coefficient can be measured in millionths of an inch per degree Fahrenheit. Special care is taken to keep the film plane parallel to the lens and to keep the film correctly aligned in the focal plane. Tolerances are in the order of 2/1000 (.002) inches or better.

Non-topographic is tricky

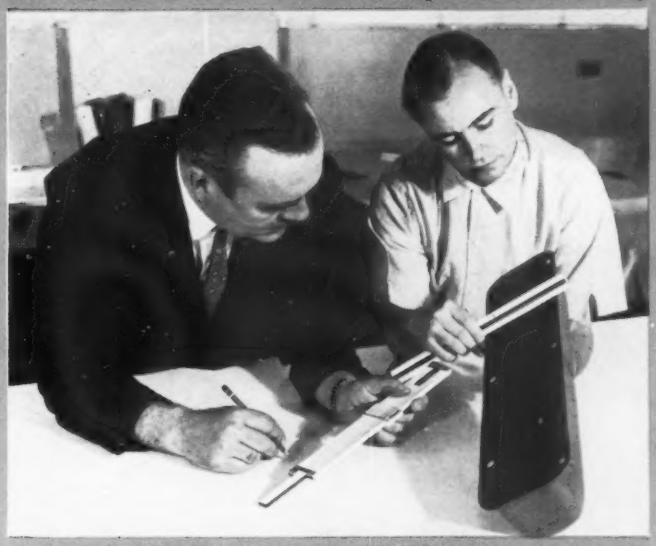
Unlike aerial cameras which operate at infinity, cameras for non-topographic use are operated at close distances which, in some cases, may be measured in inches. This means that lenses used must be calibrated for the exact focal distance of the lens not mounted at infinity but at its working distance. Distortion characteristics at these working distances must be plotted. Later, these distortions, introduced by the lens, can be corrected during rectification.

Lenses used in non-topographic work are wide-angle designs covering angles up to 90 degrees which are relatively free from distortion. Typical lenses include such types as the Avigon, Topogon, Aerogon and Orthogon. Apertures are moderate, seldom going over f/6.3. In some cases, pictures are made at f/11 or f/22 for maximum depth of field. Although the lenses have a comparatively short focal length for the size of the plate generally 9 x 9 in., they are seldom under 6 inches focal length. At close working distances, even at smaller apertures, depth of field is minimal.

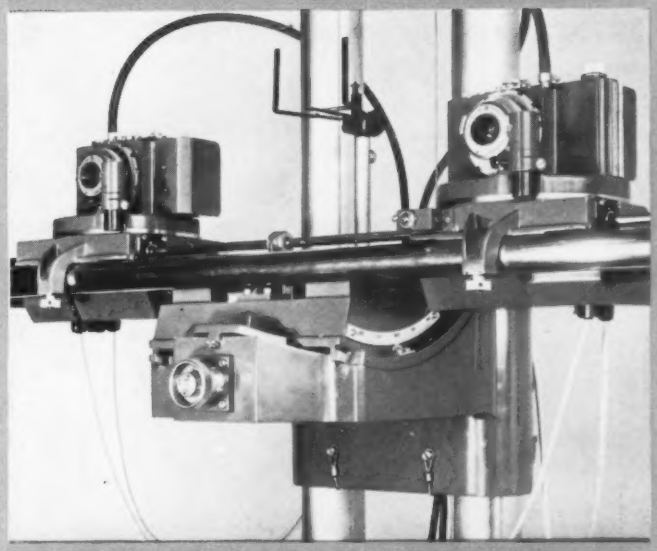
Generally, depth of field is precomputed for the distance at which a particular lens is designed to work.

Limitations on this working distance are placed not only by the camera but by the instruments used for rectification and plotting. These can generally handle pictures made at distance-to-subject-size ratio of 2:7. It is a problem in perspective: at too great a distance, planes tend

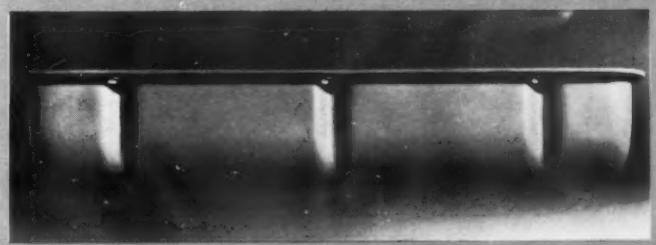
Photography: the front half of photogrammetry



An engineer and draftsman study a prototype to compute camera distance, focal length, lighting and film requirements. Work may also begin with designer's model or even engineering drawing.



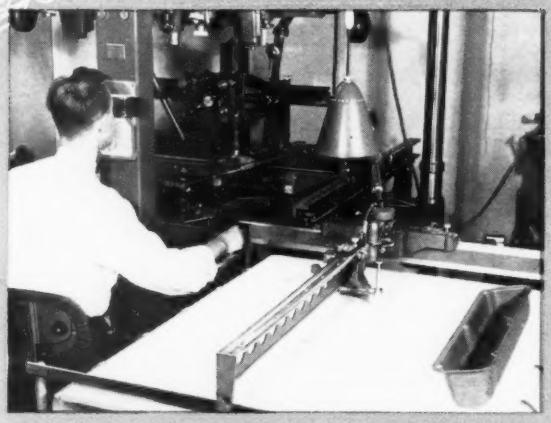
This Galileo stereo system is one of the few proprietary non-aerial camera units, more commonly an aerial camera is adapted for close-up use. Exact focal length, precise alignment are needed.

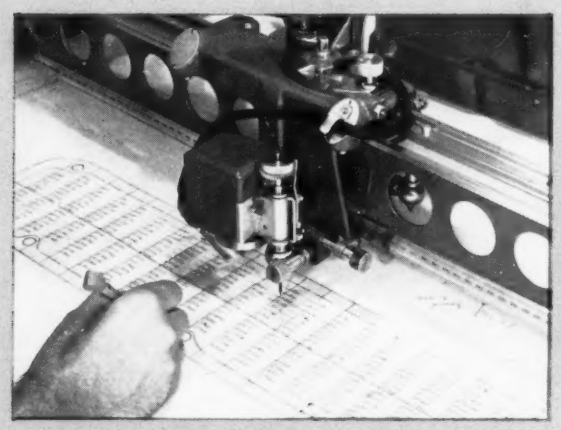


A print of half a stereo pair; the negative, however, is plotted.

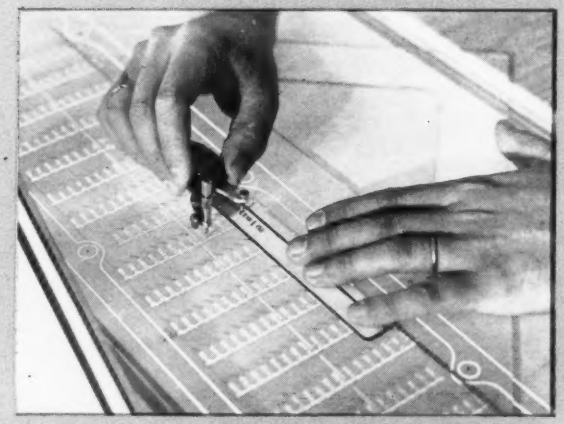
The rest is the science and art of precise optical measurement

Photogrammetry implies highly accurate analysis of photos. The reduction of photographic data is no job for an amateur. It requires professional planning, expert skill, and superb equipment. The basic tool for analysis of data from stereo pairs is the stereo plotter shown in operation at the right. By means of an intricate optical and mechanical system, diagrammed here, the operator is able to extract the location of any point in the subject in reference to its position on a plane and its height—with a degree of accuracy that physical measurement of the original object could not match. Basically, the plotter is a measuring engine. In much the same way as an optical rangefinder permits the photographer to focus his camera, it makes use of parallax between two images to mark subject position.

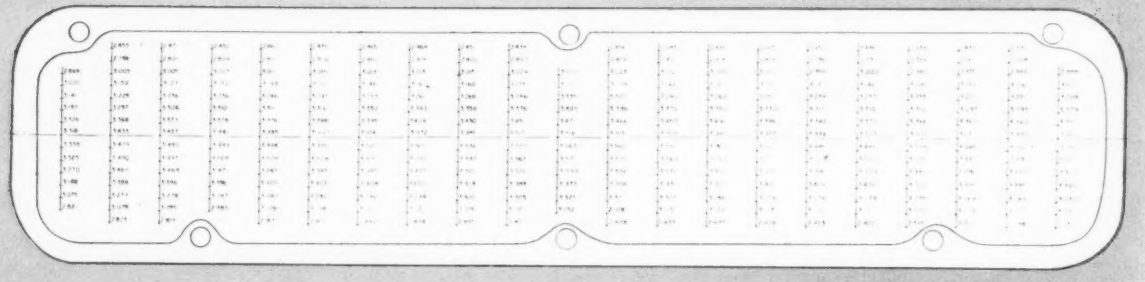




Mechanical linkage connects plotter to drawing table. Vertical distance is entered on two-dimensional plot.



Information may be read out in digits alone, on a tape, or carefully drawn and lettered as in this case.



Photogrammetric presentation of the data; from this, computer-controlled production may duplicate prototype

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to flatten out while at too close a distance, the depth between planes is exaggerated. Therefore, placing a camera at a 1:1 distance (camera distance is equal to size of subject) creates a problem in restitution, that is, reproducing an accurate picture of the subject.

Using the negative

Unlike topographic work, there is no print (diapositive) made in non-topographic work. All calibrations are made directly from the negative. These negatives are made by either a high-speed emulsion such as Plus-X or Panatomic-X (speed in photogrammetric terms, that is), a high-contrast emulsion such as Commercial or a high resolution type such as Spectroscopic.

The choice depends upon the subject to be photographed and the place of operation. A very shiny object cannot be photographed on high contrast film lest there be an opaque highlight which could not be read and plotted. Conversely, a subject with low contrast might have to be photographed with a high contrast emulsion to provide sufficient separation of various planes.

Processing may be in various formulae including D-19, Pyro, DK-60B (DK-60A with added sulfite) or a two-bath process with high-and-low contrast developer. Developing times run about four minutes at 68 deg. F. and fixing takes about 5 minutes. Hypo-clearing agents reduce washing time to about 5 minutes.

To reduce shrinkage, spray development is used, using various developing machines designed for the purpose. To reduce contrast, an electronically-controlled multivibrator giving flashes at 1/100,000 of a second may be used. The duration of flashing varies with the picture contrast.

Placement of the cameras in the field is determined by the subject, its size, the degree of overlap desired and the scale of reproduction. Generally, the cameras are placed to give about a 75 per cent overlap (each camera of the pair 'sees' 75 per cent of what the other 'sees') and to get as large a scale of reproduction as possible. Basically, the position of the cameras is determined by the photogrammetrist although the photographer may change this within specified limits if better results can be obtained as a result of the change.

To provide reference points for plotting, fiducial marks are placed in the camera. These are necessary in non-topographic work because there are no recognition points, such as defined mountain peaks or coast lines, which help the topographer.

Once the negative is made, it goes to a rectification instrument which corrects distortion, much as a photographic enlarger does. This may be a separate instrument, such as the Carl Zeiss Jena SEG-1 or it may be incorporated into the plotting instrument. Unlike the photographic enlarger, which merely provides tilting on one axis, rectification corrects for x, y and z axes (length, width and height). The degree of correction varies with the model. The SEG-1 provides easel movements from minus nine to plus 40 degrees. The Wild E-3 allows movements of 15 degrees along the x or y axis, plus movement about the diagonal. Accuracy of these machines is measured in tenths of a millimeter (about 1/250 of an inch).

The corrections are accomplished in the plotting instrument by placing an aspheric cam into the system controlling the recording arm. The surface of this cam is ground to match the distortion characteristics of the particular lens which was used to make the photograph. These characteristics are charted by such agencies as the National Bureau of Standards. As the operator plots the discrete points, the recording arm moves but the movement is modified by the cam to correct for distortions. This modification works whether the data is recorded on a chart via a plotting arm or an electronic coordinate recorder coupled to the plotter.

Who makes what

There are four major manufacturers of photogrammetric equipment who can supply a complete line from cameras to electronic data recorders, including first-order plotting instruments. "First-order" refers to the degree of accuracy possible with a given instrument, 1:10,000 or better. In other words, plotting a picture made at 10,000 ft., errors will be a foot or less.

This degree of accuracy is needed for non-topographic work, although lesser degrees are sometimes acceptable in aerial work.

The companies are Galileo-Santoni of Florence, Italy; Wild Heerbrugg, Heerbrugg, Switzerland; Carl Zeiss Jena, Jena, East Germany and Nistri, Rome, Italy, and West German Zeiss Aerotopograph.

The standard photogrammetric camera uses a 9 x 9-in. plate, but some cameras in smaller sizes are made for special applications.

Galileo, for example, offers a 6 x 9 cm. camera using ‡620 film for uses when the highest accuracy is not needed. This is a variable camera using a 75 to 85mm lens.

For more precise work, a 4 x 5-in. camera is used, giving a 4-in. square negative. Three sets of lenses may be used with this model, in focal lengths from 600 to 1250mm (22 to 50-in.). The price of this assembly is in the neighborhood of $70,000. The most precise results are obtained from a camera such as the 9 x 9-in. camera offered by Galileo, using a fixed-focus 6-in. lens which works at f/16 to f/32.

Plotting instruments vary in accuracy and scope, but all of them are basically viewing devices which permit the operator, observing the photographs, to plot information. This may be done by using a pantograph which will accurately reproduce the operators tracing on a sheet of paper. In non-topographic work, however, data is plotted by recording coordinates by means of a coordinate printer which can be attached to the plotter.

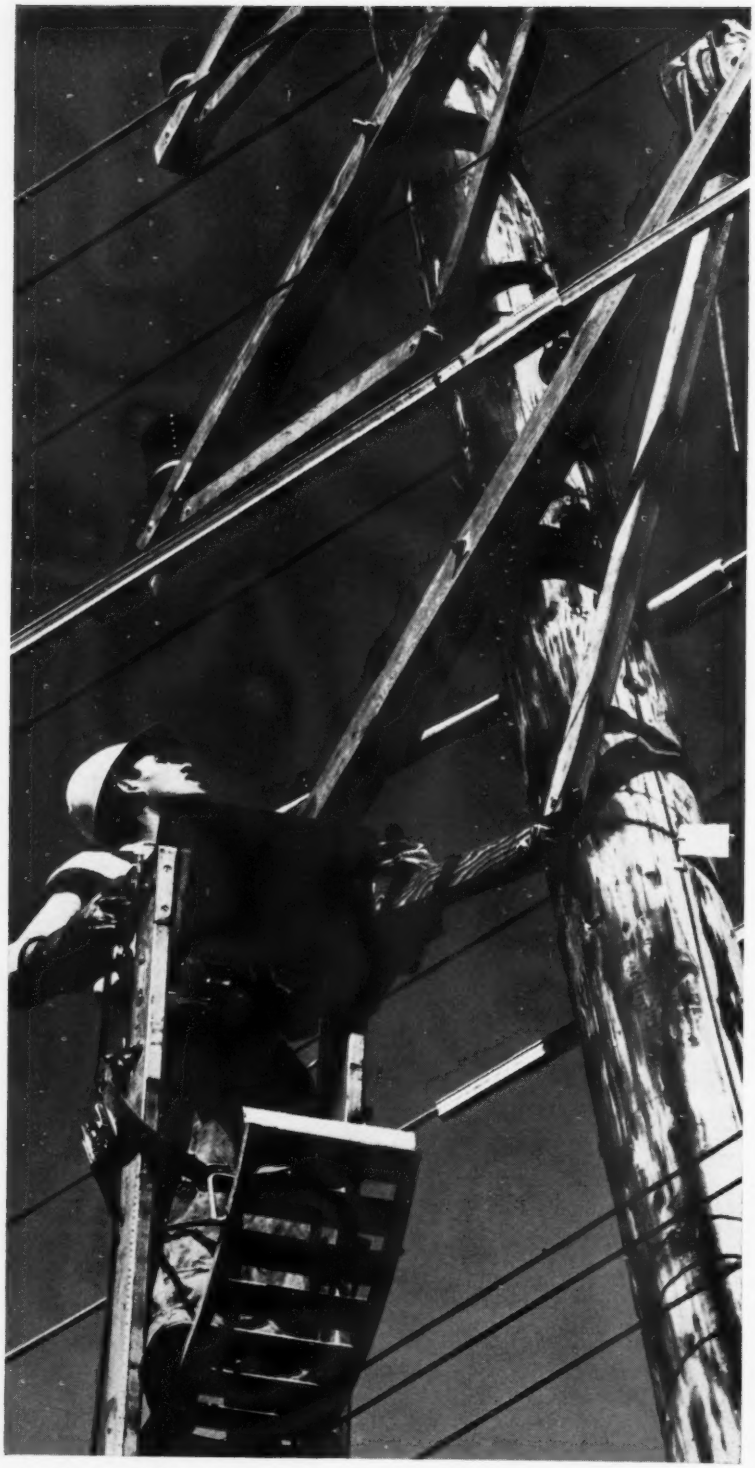
"The shape of things to come"

This use of numerical values for coordinates sets the scene for what may be a second industrial revolution equal in historic and social impact to the first. Consider this possibility:

A full-scale model of a new part is photographed using a stereo-pair of cameras. This photograph is plotted and the coordinates derived. Mathematical curve fitting provides the exact equations for every surface, every line and curve. This data is fed into a computer and comes out as a program which can control an automated production line.

Work in this area is being done under the highest degree of corporate secrecy. The security precautions covering this activity make the government's missile program seem like a tour for sightseers. In terms of significance for both

(continued on page 71)



JOAN LIFFRING, free-lance from Cedar Rapids, Ia., photographs everything from workers' children at home to the men on the job, attempting to establish the relationship between industry and society as a whole. This one was made for the Iowa Electric Light and Power Co. with a Hasselblad, 150mm lens. Exposure was 1/30 at f/8 with a red filter. Polycontrast paper with No. 3 filter.

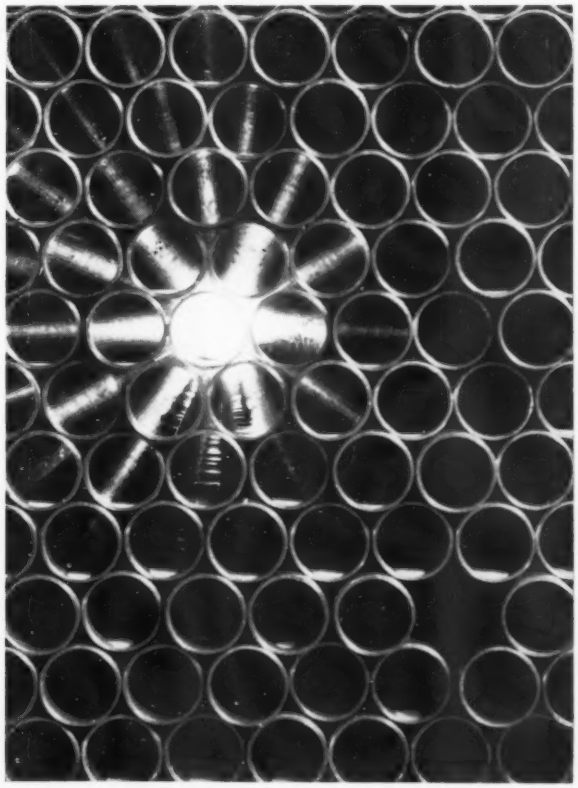
PMI's READERS' SHOWCASE

An outburst of reader enthusiasm in the form of contributions to our Showcase feature has enabled us to present these eyecatching photographs. We can use lots more, however, and wait anxiously for further submissions with $10 checks clutched in our sweaty fists. As we said before, we're partial to action and people in pictures, but offbeat and abstract subjects also get our attention. Take a good look at this month's selections and then see what you can come up with. (Oh, yes, we would like a bit of information about yourself and some technical data on the photographs you're submitting; we're not prying, really, but we do have to write captions.) Our address is: Showcase, PMI, 33 West 60th St., N.Y.C. 23.

ROBERT E. NYE works for NASA at Langley Field, Va. On a "Project Mercury" assignment aboard the *U.S.S. Recovery* last March, he photographed an engineer being picked up by a helicopter after finishing an examination of the recovered capsule. Rolleicord 5a, Plus-X; 1/250 at f/5.6.

BILLY McCRAY, an "Engineering Photographer" for Boeing Aircraft at Wichita, achieved this interesting pattern shot of a large blast fence with a Schneider wide-angle Angulon lens on a 4 x 5 Speed Graphic. He emphasized distortion in the taking and improvised in the printing for desired effect.

CARL MOORE and John Murray of the Stanford Research Institute in California teamed up on this photograph of technicians viewing the surface effects of an underground atomic blast. Moore made the photograph with Royal Pan exposed at 1/250 sec. at f/22. Murray made the prints.



G. R. WARSTLER of Republic Steel at Massillon, Ohio, photographed this stack of conduits with a 4 x 5 Linhof, 150mm Schneider lens, with Royal Pan exposed at ½ sec. A flash was fired at opposite end of pipes (8 ft. away). Warstler noticed missing pipe only after print was made.

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WHEN THE E

PP of A is meeting in New York from July 30 to August 4 with a full program of tips and trips for the in-plant photographer. Don't miss!

Writing about the forthcoming PPA Ninth Annual Industrial Conference is a little like trying to describe a circus to a kid. You just can't pick out two or three or four attractions or try to convince someone that it is really worthwhile. The fact that it is taking place is, in itself, practically the only excuse needed to attend.

However, we do have a duty to our readers to keep them informed so that they can allocate work-time and play-time wisely while they are in New York. Here, then, is a preview of the show. The time: July 30 to August 4. The place: The Statler-Hilton Hotel, New York City. The hotel is at 33rd Street and 7th Avenue, just across the street from Pennsylvania Railroad station.

Conference activities really start Friday, July 28th when PMI's David B. Eisendrath, Jr., will chair a print contest at Bergan Mall, Paramus, New Jersey's shopping center.

The Conference gets down to business Sunday morning with an Industrial Pre-Council meeting at 10 and a National Council meeting at 1 p.m. The trade show opens at 2, and at 3, David B. Eisendrath, Jr. will be moderator at a Round Table discussion. At 8, the indefatigable Mr. Eisendrath will conduct a Motion Picture Clinic. Official opening ceremonies will be at 9 in the Grand Ballroom.

Monday morning, at 9, Peter Carey of Bendix, Chairman of PPA's Industrial Division, will welcome visitors and turn the platform over to Charles Wilson of Westinghouse Electric who will deliver the keynote address.

At this point, we will now list the dates, the times and places of papers which will be given for the industrial man.

MONDAY, JULY 31

"Technical Data Presentation by Raymond Hicks of Eastman Kodak at **10,** followed by "Basic Motion Picture Techniques," H. S. Fisk, also of Eastman Kodak, at **10:45.**

At **11:30,** Ed Hansen, Southern New England Telephone Co., will discuss "Quick & Dirty Motion Picture Techniques." Despite the lurid title, this talk will cover operating techniques in an emergeny, such as the one presented by the last New England hurricane. By taking a writer along and literally writing the film at the camera, plus keeping a reserve of strategically-located commerical photographers who could work with the in-plant people, a film story was made quickly and effectively.

At **2 PM,** there will be a New Products Forum with David B. Eisendrath, Jr. **3:30** Round Tables. At **8,** a Motion Picture Clinic will be conducted by our own David B. Eisendrath, Jr. who certainly gets around.

TUESDAY, AUGUST 1

9 AM will see Charles Rotkin discuss "Aerials on a Budget," an introduction to aerial photography by a leading practitioner of the art. George Ward will discuss his technique for "Duping Color Slides" at **10,** using 35mm equipment. At **11,** "Some Problems of Missile Photoinstrumentation" by S. Lane Atkinson, Jr., RCA Service Co, Patrick AFB (Cape Canaveral). **1:30 PM** will see J. E. Gillespie, A-V Sales Manager of Ozalid, prepare a full-color transparency on the stage using Diazo materials. His presentation: "Diazo-Another Photo-Graphic Tool of Visual Communications."

Other papers offered include:

2 PM, "Bullet & Submicrosecond Photography," Dr. Harold E. Edgerton, MIT;

3 PM, "Photomacrography," Frank Manarchy, Rockford Memorial Hospital, Rockford, Illinois;

4 PM, "Instant Photography in Industry," Eric Sanford, Manchester, New Hampshire.

(*continued on page 83*)

ELITE MEET

A long, careful look at photo-instrumentation and its role in space-age defense is set for SPIE's Los Angeles meeting, August 7 to 11.

Photography and its defense role in the space age is the theme of the Sixth Annual Technical Symposium and Exhiborama of the Society of Photographic Instrumentation Engineers.

Opening August 7 for a five-day stay at Los Angeles' Ambassador Hotel, the SPIE affair will cover all phases of instrumentation. In addition to public sessions, classified sessions will be held under Air Force auspices to enable qualified persons in defense activities to compare notes and gather the latest information. The Air Force is a co-sponsor of the event.

A Technical Symposium will cover problems of space-age medicine, missile-borne television, tracking of high speed missiles and underwater instrumentation.

Speakers include:

Steven M. Lee, NOTS, China Lake, "New Approaches to Automation in Photo-Optical Instrumentation and Data Reduction;"

Edward J. Barlow, Aerospace Corp., "Management Aspects of Instrumentation;"

Dr. Heinz Nitka, Ansco, "Applications Significance of Recent Photo-Sensitive Materials Improvements;"

Steve Colletti, McDonnell Aircraft, New Techniques for On-Board Radarscope Recording with Polarized Light."

Among the classified papers are:

Donald Southard and Rudy Schlidt, Redstone Arsenal, "Missile-Borne Television Instrumentation;"

Amron Katz, Rand Corporation, "Satellite-Borne Reconnaisance."

Other topics to be presented are: Dr. Harold Edgerton, "Some New Micro-Second Recording Techniques;"

J. E. Durrenberger, White Sands Missile Range, "Immediate Future Requirements for the Design of Photo-Optical Instrumentation;"

James Haley, USAF-WADD, "Dynamic Evaluation of Airborne Reconnaisance Systems;"

Dr. Kelley, Pacific Missile Range, "Space Medicine and Human Factors in the Space Age;"

Dr. Walter Seigmund, American Optical Co., "Infrared Fiber Optics;"

Dr. C. C. Baum, TE Corporation, "Optical Telemetry."

Panel discussions and leaders include:

John Clemente, Pacific Missile Range, "Foreign Photo-Optical Instrumentation Capabilities;"

John Pflaum, NRL, "Recently-Developed Underwater Instrumentation Techniques;"

Paul Lathrop, General Electric, "Photo-Optical Requirements for Extra-Terrestial Instrumentation."

Other papers which will be presented during the course of the convention include:

R. M. Stuart, Space Electronics Corp., "SIMICOR-Photo-Optical Data Correlation;"

Lt. Col. Norman Gray, USACSAD, "A Reevaluation of Drone Reconnaisance Systems;"

Jasper Mardom, Oxford Paper, "Photographic Instrumentation in the Paper Making Industry;"

Guy Hearon, Benson-Lehner, "A New Stereo Recording Instrument with 18,000 Pairs/Second Capability;"

Paul Mooney, Autonetics Division, North American Aviation, "A New Flight Control System;"

Brig. Gen. John J. Shinkle, CG, White Sands Missile Range, "Instrumentation and the Army Weapons Program;"

R. J. Sharrer, Sandia Corp., "Computer Programmed Sled-Tracking."

Abraham Reich, Lockheed Electronics, "Photographic Techniques for Auto- and Cross-Correlation;"

Ralph Wight, Photronics Corp., "Some New Considerations of Atmospheric Optics."

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PILOT OBSERVER CAMERA

Two Milliken 16 mm pulse cameras kept Astronaut Shepard and his instrumentation panel under constant surveillance throughout the historic Mercury spacecraft flight.

The two monitoring cameras, designed and manufactured by the D. B. Milliken Company specifically for the N.A.S.A. Project Mercury "Man in Space" capsule include:

Model DBM 7B INSTRUMENT OBSERVER CAMERA, film capacity 500 ft., 20,000 frames, 7¾ lbs., including film and lens.

Model DBM 8B PILOT OBSERVER CAMERA, film capacity 250 ft., 10,000 frames, 6¾ lbs., including film and lens.

Both cameras were designed to operate at 6 frames per second during launch and re-entry and 1 frame each 10 seconds during other portions of the flight.

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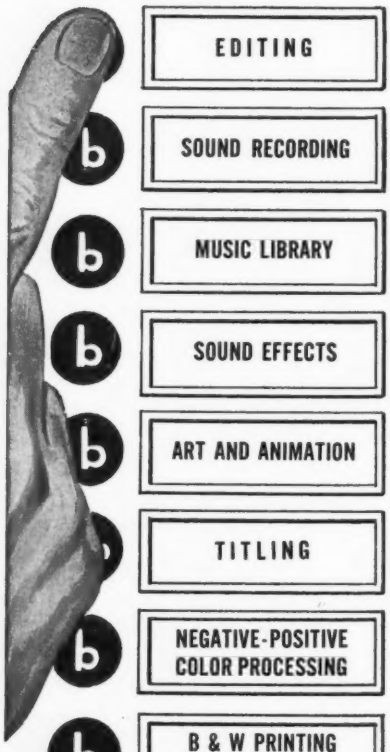

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Arnold Eagle

INDUSTRIAL MOTION PICTURES

Lighting can make or break your film: here is the basic approach

Of all the problems that confront the film maker, lighting an indoor location is probably the toughest. Regardless of the size of the production, lighting can be a real headache. Equipment is usually bulky, while transportation and setting up are physically exhausting as well as quite time consuming. The effort to secure an adequate power supply on location usually precipitates a crisis. The electrician who has the job of surveying the new location always reports, "I suggest we bring our own generators, or limit ourselves to much less light."

But, artistically speaking, movie lighting is a determining factor in movie making. A well lit film can make an otherwise poor film acceptable to an audience who will at least concede, "It was well photographed." Conversely, a poorly and unevenly lit film has little chance of being well received.

Why light?

Artificial lighting has two main functions: first, it must provide a light level for an adequate exposure; second, it should contribute to the dramatic and creative content of the film. It can produce the character, atmosphere, reality or excitement of the screen. High key or low key lighting can establish mood. They can suggest mystery and drama, or light-hearted cheerfulness. Most films are lit realistically, that is, lit to resemble the lighting that would be encountered in real life. Indoors, the lighting on the screen simulates light coming from windows or from overhead and standing light fixtures. You rarely see a light coming from beneath eye level because normally most light comes from above eye level, almost never from below.

The director (or the cameraman) is in charge of the lighting of a scene. He explains to the chief electrician the action and movement of the people in the scene; the size of the location included in the shot; the position of the camera; the character of the lighting; and the direction of the key light. Lighting of a set usually starts with setting up the key light or lights, followed by the fill-in lights which are used to light up the shadows, determining the contrast ratio. Back lights may be used to add a plastic quality to the people, and help to separate them from the background. Special lights serve to pinpoint or highlight a center of interest. Movie lighting differs in two important respects from lighting in still photography. First, in still photography, lighting involves a single situation, and usually one, two or three lights will suffice. But in cinema lighting, you have to consider various changes and movements throughout the whole take. For example: the subject may turn from full face to profile and then walk ten steps across the room. The lighting must provide for every move and position. Therefore, many more lights must be used; and individual light units must not be placed too close to the moving subject. Suppose at the start of the shot, the subject is five feet from the light, and then moves two steps closer. In this latter position, the light from the single lamp on the subject would increase greatly. Therefore, the exposure reading must take into account every subject and camera movement. This is why most movie photographers use a direct light reading exposure meter for indoor lighting. It enables the cameraman to walk through the set with the meter pointing toward the camera as he reads the light level throughout the whole location.

Of course, spot exposure meters that have a very narrow angle of view will do the job; in this case, the cameraman can stand in one spot and take a number of readings over the whole location.

A second important difference

(continued on page 56)

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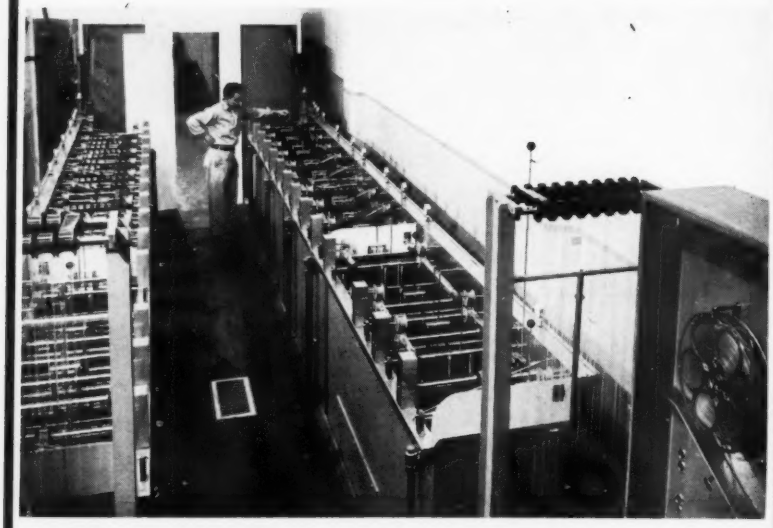

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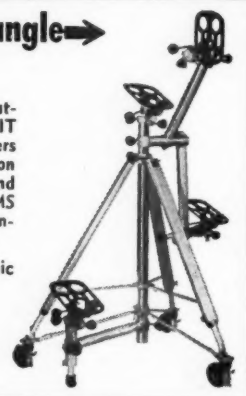

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(continued from page 54)

between still and movie lighting is in the problem of exposure. In still photography the exposure depends on the amount of light, how steady the subject is, the speed of the film and the depth of field required. If the subject is fairly steady, the photographer may extend his exposure time for as long as he wishes. This is not the case in cinematography where the cameraman is ordinarily restricted to 24 frames a second which in most cameras means 1/50 second exposure. (The exception to this is the variable degree shutter and high speed and slow motion picture photography.) This means that after reading his light the cameraman must close down his lens diaphragm regardless of his need in the depth of field. If he needs more light he can increase his light level or change the film in his camera to a different speed. He has a real problem outdoors. Most movie lenses do not close down lower than f/16 or at most, f/22. As a result he can use only very slow speed films outdoors, nothing faster than ASA 40. As an alternative, he can resort to neutral density filters to cut the light down.

Dislike small apertures

Some cameramen dislike using the very small apertures on the lenses, especially on the shorter focus lenses. It would seem a lens should be more efficient closed down, because of the increase of the depth of field. Light diffraction, however, makes lenses show a degeneration in definition when closed down. This is why professional cameramen prefer to set their lenses at a predetermined opening—somewhere between f/4.5 and f/8 for all setups. Most lenses seem to be sharpest at these stops. This means that the lighting for every setup is built up to a predetermined light level. This type of lighting is especially useful in color photography and television film lighting. Both of these types of film require a low contrast ratio and an overall evenly lit set. This type of lighting also leads to a different type of exposure and light reading. Cameramen and film processing labs, instead of speaking of ASA speed rating of a film will inform you that "Eastman Ektachrome Commercial requires 800 ft. candles at f/4 or 1600 ft. candles at f/5.6," or that "Dupont Superior 4 Type 928 16mm needs 160 ft. candles at f/5.6 or 320 f.c. at f/8."—THE END

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PMI IN-PLANT REPRODUCTION

Herbert P. Paschel

GRAPHIC ARTS

Research proves black is white in some graphic arts situations

Very often a graphic arts cameraman encounters copy that photographs in a way contrary to all expectations. An example of such a puzzling situation is the case where the highlights in a halftone negative are still open while the darker tones are plugged up and thus dropped-out. This reversal of tone relationship, while evident in the negative, is usually totally unexpected on the basis of the visual appearance of the copy. In such cases the whites of the copy do appear to be brighter than the next lower tone. But the camera says otherwise. Obviously some difference exists in the way the eye sees the copy and the way the photographic process records it. But what, and why?

Detective work

This and similar problems have plagued graphic arts photographers for generations. Dupont technicians were likewise puzzled, but set out to find an explanation. The results of their experiments and research indicate that tone distortions may occur when various copy areas have different absorption and reflection characteristics for ultra-violet radiation.

In order to understand just what happens, let's first review how copy elements modify light. If the copy densities are truly neutral they will absorb and reflect the incident radiation according to their density and in an equal manner for all the wavelengths of the radiant energy. This is called non-selective absorption and reflection. If a modifier affects certain wavelengths more than others, the action is called selective. Red and blue color patches, for example, are selective since one absorbs all but the red rays while the other reflects only the blue. According to Dupont technicians, differences in the reaction to ultraviolet rays by various areas of the copy result in the tone distortions encountered.

A particular copy area could react in any one of three ways. The modifier (paper, pigment, dye, silver grains, etc.), may absorb ultraviolet radiation and reflect the visible rays. If non-selective in action the modifier would reflect or absorb all incident radiation. The third condition may occur if the pigments involved have fluorescent properties. In this case the ultraviolet rays are converted to visible radiation. A fluorescing area thus reflects the normal amount of visible radiation present in the incident light plus that created by fluorescence. In the process of being converted to longer waves, the ultraviolet is, of course, absorbed.

Now let's go back to the situation mentioned earlier where the pure white areas reproduced darker (less negative density) than a tone area. If the white area absorbed ultraviolet, and the tone area did not, then, obviously, the amount of radiation exposing the film is greater for the tone than for the white. The film, you will realize, is sensitive to UV rays in addition to its sensitivity in the visible spectrum. The same sort of distortion would occur if the white area absorbed UV and the tone fluoresced.

Eyes don't have it

The reason this sort of distortion is not evident to, or predictable by the cameraman is that the human eye is not responsive to short wave (UV) radiation in respect to visual sensations. Because of this, the actinic or photographic brightness relationship of a copy may be entirely different than the brightness relationship evaluated visually.

Mix up

The problem is seldom encountered with unretouched photographs but quite often with art work and retouched prints. This can be attributed to the fact that

(continued on page 60)

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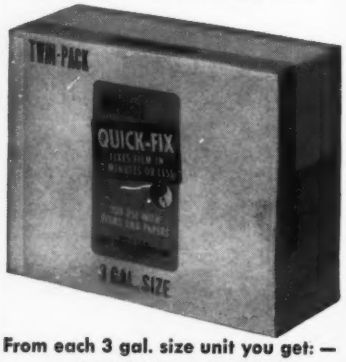

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(continued from page 58)

drawing materials may contain substances with dissimilar properties. If indiscriminately mixed in preparing art work a photographer's headache is created.

Drawing paper and board often contain brighteners which are essentially fluorescing pigments or dyes. Similar substances are often added to paints and other drawing media, or the ingredients themselves may have inherent fluorescent qualities. In contrast to this, there are any number of chemicals that have the ability to quench fluorescence and these too may be present in drawing materials. Two fluorescent materials, when combined or applied one over the other can, in some instances, interact to quench fluorescence.

As is obvious, incompatible materials used in preparing art work could therefore, quite unintentionally and unknown to the artist, create a variety of areas with different reflection properties. The incompatibility of art media was at one time a serious problem that plagued the users of the patented halftone dropout processes based on the fluorescent effect.

Nipped in the bud

To eliminate the problems due to the various UV effects, Dupont suggests filtering out the UV component of the camera lamps before the light reaches the copyboard. This can be readily accomplished by placing suitable filter material in front of the lamps. Dupont Weatherable Mylar Type W is recommended for this purpose. This film has a special UV absorbing coating but does not otherwise cut down the light appreciably. With only radiation in the visible spectrum reaching the copy, all copy elements will reflect and absorb according to visual density differences.

The Dupont technique is helpful in alleviating tone distortions induced by the ultraviolet phenomena. There are, however, many other causes for unexpected results. Selected absorption in the visible spectrum of densities assumed to be neutral; extremes in surface characteristics creating highly diffuse and spectral reflections, polarization and other effects may explain other instances of tone distortion. The final solution to these, as well as the UV problem, is to avoid creating copy with dissimilar reflective areas.

—THE END

When you can't tell what will happen, Ektachrome ER Film protects you

Out on the ranges, many things are being filmed today that are not subject to nice, convenient prediction for the guidance and benefit of the photographic crew.

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Yet the affair is being run for the purpose of providing information from the color film. When the pressure is on and the question marks are large, the color film had better be Ektachrome ER.

Ektachrome ER Film, Daylight Type, has an exposure index of 160; *Type B,* 125. (It is still a little hard to believe that color film could be that fast.) Exposed on this basis, it gives high definition and color differentiation so vivid that those who have to reach decisions from looking at the results feel a surprising sense of accentuated perception.

Equally important—perhaps more important—is the way Ektachrome ER Film hangs onto its definition and color differentiation when circumstances foul up the calculated ideal exposure settings. Expose it at an effective index considerably above the recommended figures, and it will often take a corps of critics to detect the difference in results. Remember, too, that tolerance to overexposure is likewise handy. We have seen Ektachrome ER Daylight Type footage shot at effective exposure index as low as 24. With compensation in the first development, it shows only a tiny difference in color balance as the only evidence of maltreatment.

One more point is worth noting. Both types of Ektachrome ER Film and Ektachrome Reversal Print Film can be processed in exactly the same way. Further, if you don't want to do it yourself, processing is now widely available.

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PMI IN-PLANT REPRODUCTION

Vernon Tate

MICROREPRODUCTION

The role of microfilm in managing a stockpile of necessary data

Information doesn't do anyone much good unless he can find it. In last month's column attention was drawn to the fact that compilations of data have an alarming way of growing like compound interest. But the bigger a stock of data gets, the harder it becomes to manage and search. In other words, every human activity which relies on documents is faced with the nightmare of having so much data it becomes useless by virtue of its own bulk. How will this problem be faced, and solved? Microreproduction is certainly in the forefront of present and planned solutions.

Industry problems

Suppose *your* problem is centered about the organization, control and effective use within a budget that is never quite adequate for records like any one of the following: land title documents with accompanying plots, maps and surveys; insurance records with accompanying documentation (the Veterans Administration alone has more than 6,000,000 accounts); patents with accompanying drawings and specifications (there are now about 3,000,000 U.S. patents and there is real need to provide access to the entire file at possibly 9 or 12 regional centers throughout the country); medical reports including case records and the documentation of research programs seeking to stamp out afflictions like cancer, heart disease, arthritis and the like, sometimes X-rays may be involved; tax records and substantiating documentation; pension and retirement files; law documents, briefs, court decisions; a business or industry with a volume of sales, research or similar material. Some business documentation files contain as many as a million documents and the doubling cycle may be as low as three years. A contractor or subcontractor with files of plans, specifications, drawings and computations; a news agency or information center or a law enforcement agency with fingerprint and identification files all have many common problems. Even the encyclopedic compilation in science presents grave problems: *Chemical Abtracts*, the foundation of modern chemistry and an absolutely indispensible tool, is a good example. This brief list is merely suggestive and could be expanded indefinitely in terms of size, area of coverage and degree.

In each of the above, microphotographic reproduction is now rendering valuable services. In many cases present methods of access to material on microfilm are quite adequate. But in some instances they are too slow, or if they could be speeded without excessive cost penalty, the product would be more useful. To meet expanded needs and to extend the scope of effective record utilization, high-speed data selection and facsimile reproduction from microfilm has emerged from the laboratory prototype stages and is now being put to work.

At the outset it must be understood that high-speed microform data searching is not competitive with the mechanical or electronic digital or analog computing machines. Computers are concerned with the handling of mathematical or statistical data. If a problem can be described and solved in these terms it is usually better and cheaper to use them. When, however, the need for facsimile reproduction of an original is paramount, then computing mechanisms alone will not serve, even though many of their theories and concepts as well as some of their mechanisms and methods may be used.

A key for the treasure chest

Microfilm *plus* is the basis of high-speed microform data utilization. The "plus" requires the addition to

(continued on page 64)

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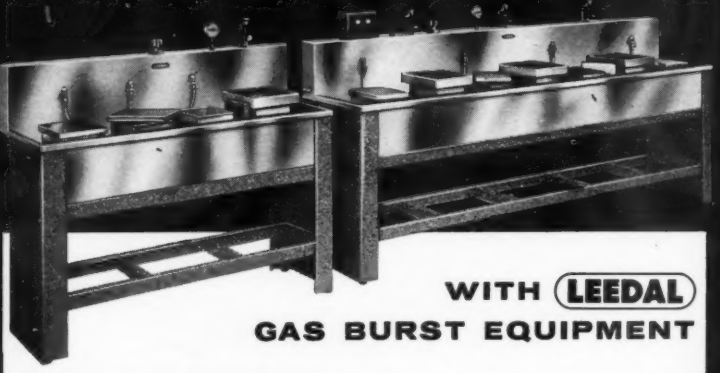

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MICROREPRODUCTION

(continued from page 62)

the microfilm image means which will identify the *content* of the document reproduced to a degree sufficient for the purpose, and the perfection of methods which will select a particular document or series of related documents from an entire file, produce it for use on a reading screen, at need make hard copy reproductions, and return the microfilm file to storage.

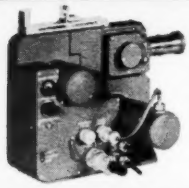
The importance of classification is at once apparent. Classification seeks to bring like materials together. In the library world among the many classifications that have been and are being used, three stand out. These are the Dewey and Universal Decimal Systems and the Library of Congress Classification. By subdividing the entire field of human knowledge into logical classes it is possible to provide compartments so to speak into which any printed work may be fitted and which bear precise relationships to other titles in the same and related fields. The classifier is followed by the cataloger who assigns the individual volume to a specified place, prepares cards for the catalog, and who may assign subject headings so that the work may be readily located by subject. The analogy of the library card catalog is really quite close to the theory at least of machine searching codes; the human brain instructed in the system used performs the searching function and library organization, hopefully, produces the volume required.

Documents, however, are not as easy to identify as books, and the greater the desired precision of reference, the greater the difficulties of classification and coding. It is quite as necessary to know the right questions to ask of a coding system in order to elicit the desired information as it is to set up and apply a code in the first instance. One of the important difficulties in coding is the fact that to code a file for the use of an inquirer whose needs are of a relatively high order, the individual doing the coding must be capable of understanding the field very well indeed. Brains of this type are often expensive, and it is hard to attract the requisite intelligence and training for a task that can become monotonous.

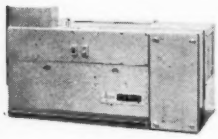
The whole system has been described as an unending contest where on the one hand the analyst and coder strive to place a docu-

(continued on page 66)

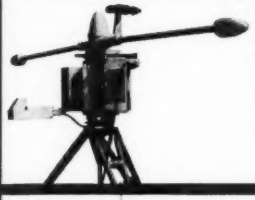
PRECISION EQUIPMENT FOR PHOTO INSTRUMENTATION

1 

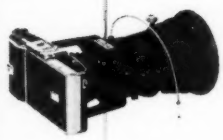
HS401 High Speed Camera Speeds up to 8,000 pps. Dynamic braking action for start-stop operation. 400′ capacity. 24 lbs.

2 

Mini-Rapid F316A Portable Film Processor. Negative 16mm at speeds to 6fpm. Daylight loading. Self threading. Fully automatic control. 65 lbs.

3 

Photographic Flight Analyzer records flight data as a self-plotted photographic chart. Trajectories, takeoff and landing characteristics, verticals, horizontals, angles. Timing is measurable to .0005 seconds.

4 

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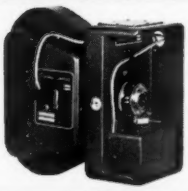
HS101 Camera shown with HS504-C1 Top Speed motor kit. Drives at 8,000 pps. Magnetic braking and drag adjustment. Controls in separate miniature package.

7 

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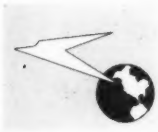

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(continued from page 64)

ment in precise unmistakable relationship within a system so that even the most obtuse inquirer cannot fail to find it, while on the other hand the user approaches the file determined to locate the document regardless of where the analyst or coder has secreted it.

Document analysis, coding and systems are far too complicated in theory and application to attempt to discuss within the limitations of a column. There is an extensive published literature. Those who are interested would do well to read through the files of *American Documentation* and to follow up the references it will provide in profusion.

Assuming that a suitable code has been devised it is usually applied to a document in the form of a dot or other pattern on a grid which carries the coding in a form that may be sensed or read by electronic means. Code and document are photographed together on a camera designed for the purpose. After the film has been processed and checked it is ready for use by any one of several systems. The film is run through a reading scanner whose mechanism is sensitized to look for particular coding marks. When scanner instructions and identification on the film coincide, the machine stops so that the image can be read or, alternatively, so that a same size or enlarged copy (blow back) can be made.

An ingenious searcher

In another column mention was made of the Rapid selector. A recently anounced machine operating on somewhat the same plan is the FMA FileSearch system (FMA, Inc., El Segundo, Calif.). Here in simplest outline is the way the system works. The basis is a 1,000-ft. roll of 35mm double perforated microfilm which will contain 42,000 pages of material at 24:1 reduction ratio. The document is photographed on a specially built planetary camera which at the same time reproduces a "code field" on the same frame. The code field provides 480 binary indexing bits or opaque dots per frame. Documents coded in any one of several methods which may identify them by number, names of subjects, key words or in terms of a standard classification. The identification can be made to an abstract or a full document or both.

A file once coded and microfilmed becomes in effect a microfilm library. A searching machine re-

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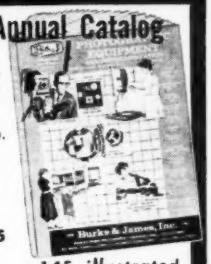

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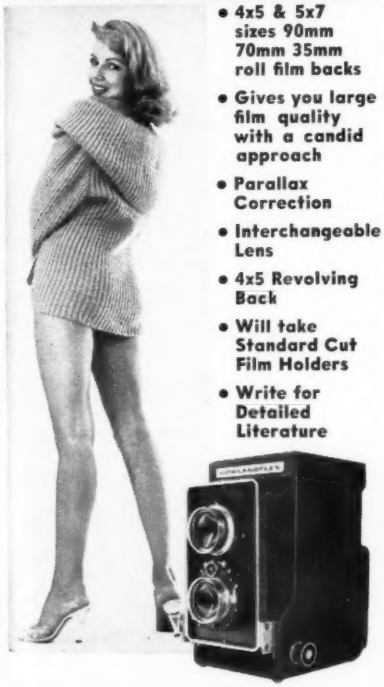

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ceives a request *phrased in coding terms.* The request may be entered in three 10-character or six 5-character groupings. Searching proceeds at the rate of 200 ft. or 4200 frames per minute. When the desired material is found, the machine stops for viewing or the making of a print. Each time the film is run through the machine is termed a "pass" and it is estimated that the machine film life is in excess of 10,000 passes. Of course it is quite easy and not expensive to make up a duplicate searching film from the negative as is standard practice in some other systems.

FileSearch permits a mass of information to be organized according to a coding system with a fairly high degree of refinement. By displaying a document for review before making a print, it is economical of paper and time. Moreover as the entire reel is searched, the infiling of new data is not difficult. By some standards the system might be considered slow, for the system requires 5 min. to search a 1000 ft. reel of microfilm.

Time factors approximating 18½ min. for searching a library of 15,000 reports each containing eight pages have been reported. The several factors break down as follows: input of search, 1 min.; search library (three reels), 15 min.; stop and start film ½ min.; change reels, 1 min.; print five documents four frames (eight pages), 1 min. There might be some objection to handling and storing the 1,000-ft. reels but with properly designed equipment these should be minimal. No cost data are presently available although it has been stated that the entire equipment could be procured for less than $150,000. The possibility also exists with this as with similar systems that the initial films can be prepared centrally to order with the user requiring only the storage reading and print out equipment; this ought to reduce equipment costs substantially.

All in all this development is most interesting and significant. Until a body of practical experience can be gained, the real impact of the system cannot be predicted. There are other approaches to the same general idea. One of these will form the subject of an early column.

77

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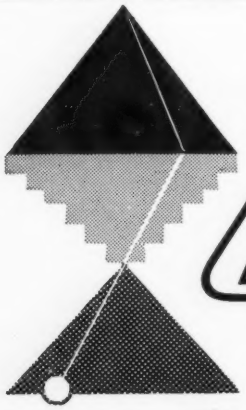

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PRACTICAL HIGH SPEED

(continued from page 37)

your problem and provide the necessary information.

First, how much does a high-speed camera cost? This varies, depending on what you have decided you need to solve your problems. Referring to pages 38-39, $7000 will buy you the most expensive 16mm camera on the list. If your needs are typical, you can get by for as little as $2000 to $2500 including some accessories. Once you have a camera, how much money is involved in its operation and maintenance? A typical industrial application probably requires between 5 and 10 rolls of film at $8 to $10 per roll including processing. Considering operator's time and materials, each day's application to a problem may range in cost from $75 to $150.

It might be mentioned here that hiring a professional consultant on your first application has several advantages. First, it permits you to get into operation quickly, with a minimum initial investment. In addition, the consultant can advise you on other application areas, what equipment to buy, and how to use your facilities most effectively.

If capital expenditure appears too costly at first glance, you might consider borrowing equipment from a neighboring plant or leasing a camera for the duration of your first project. High-speed camera rentals vary between 15 and 25 per cent of the list price of the camera per month of rental. Accessories usually run 10 to 20 per cent of list per month. High-speed cameras are available for rental from large motion picture supply houses (see PMI Directory, 1960, p. 234-5) and, in some cases, from manufacturers and their representatives.

However, very often the solution of your first problem will pay for a camera and its yearly operating cost many times over. Solving problems that result in increased rate of production, reduced scrap or increased tool or machine life yield tremendous savings over a period of weeks, months or years.

Get a paper and pencil

Here's how to estimate these cost savings. With the help of someone close to the problem, estimate the chances of coming up with a solution if high-speed photography is used. Preferably, get estimates from several people whose opinion you respect. Arrive at a "best estimate"

by averaging these results. Multiply this factor times anticipated dollar savings that would result from solving the problem to obtain a figure for "probable cost savings."

Let's take an example. A punch press operation is spoiling more than 25 parts an hour because of a faulty ejection mechanism. This seems to be a design defect, but scrap is less than 1%, so the problem has been neglected. Parts are worth 10¢ each, which amounts to a total scrap loss of $25 \times 0.10 = \$2.50$ per hour. The engineering department estimates that they would have at least a 50 per cent chance of completely solving the problem if they could just see what was going on during the ejection cycle. So, probable hourly savings are $0.50 \times \$2.50$ or \$1.25. This amounts to $8 \times \$1.25$ or \$10 per day, \$50 per week and over \$2000 per year—enough to buy a high-speed camera!

Engineering time to be saved by being able to see the action in slow motion and pinpointing the problem can also be "guestimated" and expressed in terms of dollars and cents. Go over your list of potential applications with those people who are best informed on each problem and get their estimates of time and money to be saved. Drawing a figure out of the air, so to speak, takes courage, but only by expressing it in numbers and performing the arithmetic can you arrive at a dollar value for the rate of return on your high-speed photographic investment. Obviously, many problem areas cannot be evaluated in this manner, so don't underrate the intuitive response which often proves to be more accurate than the results of an analytical approach anyway. The answer based on the intuitive leap is more difficult to sell to the boss, however. Research applications fall in this category. In these cases, try to come up with a qualitative evaluation of the application—an expression in words, not numbers—of high-speed photography's value in throwing new light on the problem.

Break-even point

Companies vary considerably on their policies toward capital expenditures, but as a rule if you can show that high-speed photography will pay its own way over a period of 3 to 4 years, you have established a pretty good argument in favor of procuring your own facilities. If the capital expenditure is too high based on your estimated rate of return, then consider hiring a professional or renting a camera to solve

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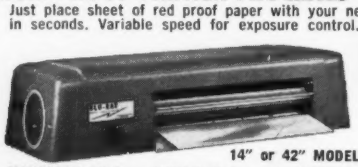

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individual problems. This is almost certain to generate new interest and bring additional problems to light. Both you and your company will benefit from getting your first taste of what high-speed photography has to offer. Now that you are convinced that high-speed photography has a place in your company's future, let's go on to the next and final question.

How to sell it

The logical first step in presenting a proven new idea for managerial action lies in the memo or written report. This means getting your ideas down on paper. Here are several rules to follow:

1) Remember, a memo or report is written to be read—so make it readable.

2) Executives (like photographers) are busy people—so make it concise and to the point.

3) Again, remember, managers think in terms of dollars and cents—saved vs. spent—so emphasize this point.

4) The boss wants facts, not personal opinions. Document your statements with specific article or book references or confirming opinions of specialists in the field (including those in your own organization). If you have a particularly good reference that fits your case in point, clip it to your report.

5) Don't overlook the importance of drawing management's attention to what your competition is doing in this field. If a competitive company uses high-speed photography, strengthen your argument by emphasizing this point in your report.

With your memo on its way, be patient, but not idle. Arrange for your management to see a demonstration film obtained from one of the several camera manufacturers. Invite your dealer in to give a camera demonstration. Perhaps he can add weight to your argument. Continue to keep abreast of new developments. Send tear sheets of pertinent articles to those concerned within your organization. Before you know it, your idea will sell itself. Let me be the first to welcome you to the ranks of high-speed photographers!—THE END

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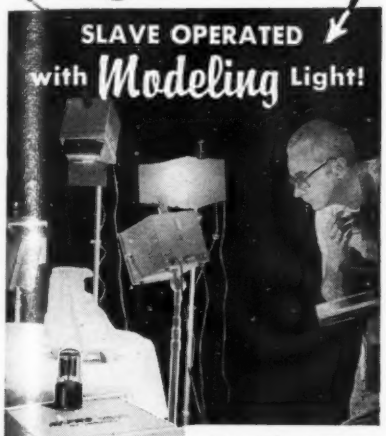

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PHOTOGRAMMETRY
(continued from page 49)

the economy and non-topographic photogrammetry, this area has perhaps the greatest importance.

In less lofty terms, where does non-topographic photogrammetry fit into the average in-plant photo department? For all practical purposes, it doesn't.

First, equipment for photogrammetry is not cheap. Cameras range from $12,000 to $18,000 (and up). Plotters may be anywhere from $20,000 to $80,000, depending upon accuracy and scope. A basic installation will run well over $100,000 and firms in the field value their installations in seven figures.

Secondly, the skill and training required make it unlikely that the in-plant photographer will do much more than make the exposure and process the negative. Planning the project and supervising its execution is done by a photogrammetrist while the plotting of results is done by highly-skilled operators.

One expert considers a good engineering or scientific education a minimum requirement in Civil or Mechanical Engineering or in Physics. In addition, there must be a thorough knowledge of photography including optics and emulsion techniques. Most helpful is a knowledge of mechanics and electronics for handling the equipment. Finally, a complete knowledge of mathematics which will enable him to prepare equations for computer programming.

With this background plus about 5 years of experience, a photogrammetrist can be considered qualified to handle a program.

In the light of these qualifications, plus the shortage of people, salary levels are fairly high, although not exceptional for scientific or engineering personnel. A beginning photogrammetrist, just out of school, may start at $7,000. Experienced people receive $12,000 and up. Operators, who man plotting machines, receive about $120 to $140 a week, depending upon skill and experience.

This has been a brief and highly simplified look at non-topographic photogrammetry. This is still a new field and nobody knows how much will be done using these methods. There is probably a point where the costs begin to outweigh benefits and make photogrammetry relatively uneconomical. There is little doubt, however, that it is destined to become an important basic tool of industry.—THE END

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FREE LITERATURE

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AUDIO-VISUAL

DUAL REAR SCREEN PROJECTOR 201
Federal Mfg. & Eng. Corp. 3-hole punched sheet, describes the TSC dual rear screen projector for televised productions. Optical, mechanical specifications.

STANDARD FILMSTRIP LIBRARY 202
Jack C. Coffey Co., Inc. 8-page catalog on projection equipment, mobile projection tables and stands, etc., for filmstrips, sound filmstrips, disc records, recording tape and 2" x 2" slides. Specifications and prices.

TRANSMAGNEMITES 203
Amplifier Corp. of America. 6-page illustrated folder describes the Amplifier line of professional transistorized battery-operated spring-motor tape recorders. Lists specifications.

MARK-Q-MATIC 204
General Techniques, Inc. 2-page brochure describes the Mark-Q-Matic slide projector synchronized tape recorder. Gives instructions and prices.

PROJECTION EQUIPMENT 205
Van Der Schalie Corp. Illustrated catalog folder describes some automatic continuous projection equipment for motion pictures, slide film and slides.

OPTIVOX 207
Advance Furnace Co. 4-page folder describes with illustrations the Optivox Visual Aid Easel. Gives complete specifications, usage and prices.

AUDIO-VISUAL ENGINEERING 208
Pictronics Corp. 4-page folder describes new Pictronics Audio-Visual Engineering and Equipment Center. Illustrates facilities, lists services.

MOOD MUSIC 209
Thomas J. Valentino, Inc. 5-page supplemented catalog of mood music.

PROJECTION SCREENS 210
Radiant Mfg. Corp. Envelope containing illustrated sheets describing such projection screens as the "PM" Picture Master, "CMO" Color Master, Autoelectric Compact, "T" Tablette and many others. Includes price list.

PHOTOGRAMMETRIC CAMERA 212
Officine Galileo. 4-page illustrated brochure describing the Galileo-Santoni Model VI Photogrammetric Aerial Camera. Also describes the shock-absorbing mount, and the Cinederivometer (viewer and intervalometer combination).

INTERFEROMETER 213
Zoomar, Inc. 12-page illustrated booklet includes definition of interferometry, a description of the new Schardin-Mach-Zehnder Interferometer (its design and operation), and specifications.

PRICE LIST 214
Charles A. Hulcher Co., Inc. 3-page price list for Hulcher 70, Model 102 Camera and related equipment.

REGISCOPE 215
Regiscope Corp. of America. 4-page folder describes and illustrates the Regiscope camera which records a person, document, and code number on a single frame of microfilm for business security purposes. Shows the line of single and dual-lens regiscope cameras.

RAPTAR LENSES 216
Wollensak Optical Co. 3-page folder describes the Wollensak PRO-35 and PRO-70 Raptar Lenses for Vidicon TV Surveillance, Data Recording, Radar Error Measurement, TV Theatrical and Documentary and Aerial Reconnaissance. Gives specifications.

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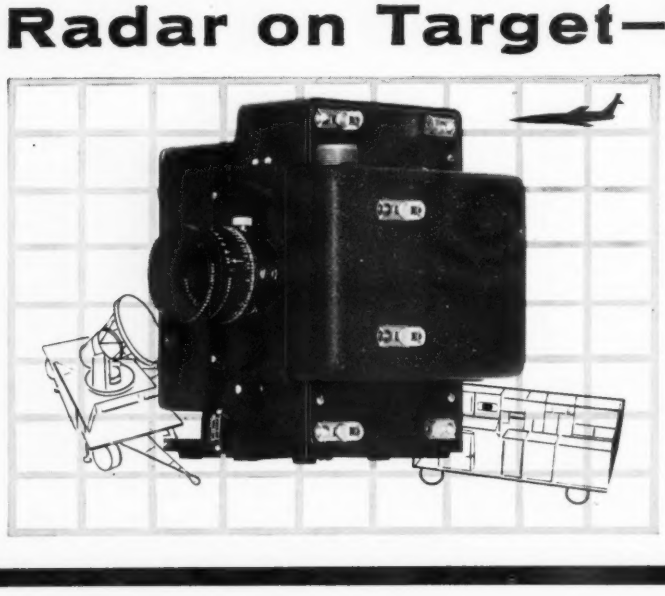

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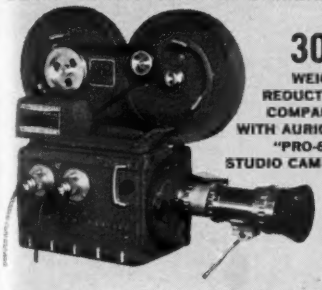

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RECORDING CAMERA 211
OPTOmechanisms, Inc. 4-page illustrated leaflet describes the Sentinel III, 35mm Camera. Analyzes parts, lists accessories and specifications.

REGISTRATION CAMERA 217
Photo Animation, Inc. Specifications and prices for the ACME-PORTMAN 16-35 interchangeable registration camera.

REFLEX SYSTEM 218
Minolta Cameras. 10-page illustrated brochure describing Minolta SR-1 single lens reflex system. Lists accessories and gives prices and specifications.

EQUIPMENT

RAPID PROCESSING PROJECTOR 222
Kelvin & Hughes America Corp. 6-page illustrated folder gives detailed description of the Kelvin Hughes rapid processing photographic projector.

SENSITOMETRY BOOKLET 225
Gevaert Co. of America, Inc. 21-page illustrated edition on the elementary principles and terminology of sensitometry. Gives technical cross-section information on the whole sensitometry technique. Also contains charts of general characteristic curves of the emulsions and a chart of common logarithms.

APAC PRINTERS 226
American Photographic Appliance Corp. 19-page illustrated catalog of APAC Printers. Lists accessories, prices and specifications.

SALESMEN'S SAMPLE CASES 227
Fibre Mfg. Co. 31-page catalog of salesmen's sample cases. Illustrates all types of cases, gives specifications, and prices.

FREQUENCY & TIME STANDARDS
Hewlett Packard Co. 56-page manual of frequency and time standard systems. Divided into four sections: I, general problems of frequency and time control, radio propagation, time scales, etc. II, III and IV detailed consideration of system operation, frequency determination, and time determination. Write to: Harry J. Lewenstein, Hewlett-Packard Co., 1501 Page Mill Road, Palo Alto, Calif.

PRESTO-SPLICER 228
Prestoseal Mfg. Corp. Illustrated sheet describes the various types of Presto-Splicers for all paper and magnetic tapes. Gives advantages, outstanding features, technical data and price schedule.

PRICE LIST 230
Macbeth Instrument Corp. Price list for Quantalog photometers and densitometers, 110 V. 50/60 cycle operation. Lists accessories and model numbers.

AIR-COMPRESSORS 231
Bell & Gossett Co. 12-page, 3-hole punched illustrated bulletin of oil-less compressors and vacuum pumps. Gives uses and specifications.

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Sekonic, Inc. 4-page leaflet describes the Sekonic L-88 Microlite battery powered cadmium sulfide exposure meter.

EXPOSURE METER 224
Daystrom, Inc. 6-page folder describes the Weston Master IV exposure meter for any camera, film or light.

GRAPHIC ARTS

METEOR PHOTOCOPY MACHINE 232
Photorapid Corp. Description sheet for the new Photorapid Meteor photocopy machine. Reproduces copies from bound books without removing pages and produces permanent black-and-white copies. Gives specifications.

"ROLLACOPIER" 234
Andrews Paper & Chemical Co., Inc. 2-page illustrated specification sheet describes Rollacopier "17" for microfilm enlargements and contact prints. Gives price.

LACEY-LUCI CATALOG 235
Lacey-Luci Products, Inc. 10-page catalog describing the Lacey-Luci line of art aids, visualizers and process cameras for various types of jobs. Includes specifications and prices.

LAMINATING PRESSES 236
Seal, Inc. Illustrated sheet describes 5 models in the Seal line of laminating presses. Gives instructions, specifications and prices. Includes a description of Sealamin Mylar laminating film.

MASK-O-NEG 237
Mask-O-Neg. 14-page illustrated booklet describes wide use of veloxes in the graphic arts field.

GRAPHICHEMICALS 238
Hurst Plastics. Price list folder for graphic arts supplies. Describes special additives and overprint varnishes. Includes prices.

DRY MOUNTING METHOD 239
Seal, Inc. 23-page manual entitled *Better Mounting* describes the automatic dry mounting method. Illustrates and describes many of the models used for this purpose.

WHITEPRINTER 240
Ozalid. Two-Color brochure describes the Ozalid Streamline "200" whiteprinter and accessories. Gives details of power requirements dimensions.

MACROSTAT 241
Karl Heitz, Inc. 4-page illustrated brochure describes the ALPA Macrostat copy and close-up stand, for Macro-photography and copy work. Includes detailed analysis of individual components and lists specifications.

COLORTRAN SYSTEM 242
Natural Lighting Corp. 4-page illustrated leaflet describes new Colortran developments for the graphic arts.

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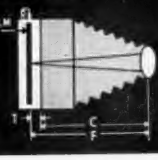

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MOTION PICTURES

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Tel-Anima Precision Products. 10-page price list for Tel-Animastand, Tel-Animaprint and other animation accessories. Gives stock numbers and prices.

ANIMATION EQUIPMENT 244
J. G. Saltzman, Inc. 6-page illustrated folder describes Model No. 11-E animation and special effects camera stand, Models No. 111 and 111-D animation stands. Includes features and specifications.

MOTION PICTURE CAMERAS 245
Fairchild Camera and Instrument Corp. 6-page illustrated booklet describes the Fairchild line of High Speed Motion Picture Analysis Cameras.

RENTAL LIST 246
Charles Ross, Inc. 8-page rental price list of lighting props, generators and grip equipment for cine and television studios.

TITLING AND SPECIAL EFFECTS 247
S.O.S. Cinema Supply Corp. 4-page leaflet describes two titler and special effects kits with illustrations and specifications. Lists prices.

F&B RENTAL RATES 248
Florman & Babb, Inc. 16-page booklet of a schedule of rental rates for professional motion picture and production equipment.

CECO RENTAL PRICE LIST 249
Camera Equipment Co., Inc. 10-page rental price list for motion picture production and editing equipment. Gives prices for both daily and weekly rental services.

SERVICES

RECORDING RATES 250
Fine Recording, Inc. 6-page booklet lists rates for use of recording studio and film facilities. Describes types of studios available.

PRICE LIST 251
Cine-Chrome Labs., Inc. Available price list showing many additional services of Cine-Chrome Labs.

COLOR GUIDE 252
Kafka Color Labs., Inc. 8-page booklet entitled "Your Color Guide For Better Pictures." Contains price lists for various services of Kafka Labs. Includes mailing envelope.

LOGETRONIC 253
Geoffrey Frazer Photography. 4-page leaflet of a trade price list for LogEtronic Photographic Prints (B&W) from 35 m/m 50 5 x 5 negative.

PRICE LIST 254
Peerless Film Processing Corp. 5-page price list of services rendered by Peerless Film Processing Corp.

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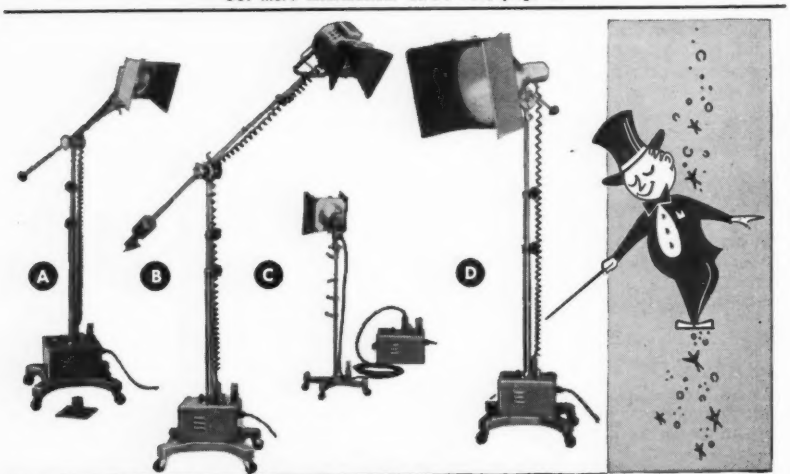

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W&L PRICE LIST 255
Weiman & Lester Photoservices. 19-page booklet of photoservices and prices of this New York lab.

COLOR SERVICE 232
Jack Ward Color Service, Inc. 12-page booklet outlines color services available from this N.Y. lab and includes prices.

PRICE LIST 258
Lab-TV. 6-page folder of prices for Lab-TV services. Includes Rating Chart, 16mm Reversal Black-and-White Services, 16mm Reversal Color Services, Lab hours, and overtime charges.

FILM SERVICES 259
Bartlett Research, Inc. 6-page folder illustrates and describes the Film Services Div. of Bartlett Research. Also describes the Cox Auto-Fade portable sound-slide system for 35mm slide presentation and Burton Holmes Travelettes 35mm travel slides.

LAB TESTING SERVICES 260
Rototest Labs., Inc., 4-page booklet illustrates and describes Rototest Labs capabilities from simple tests to poly-environmental requirements.

SUPPLIES

DATA SHEET 261
Ansco. Data sheet with description, characteristics, exposure, and processing procedures for Anscochrome film. Also includes a speed variation developing timetable.

ACUFINE CHEMICALS 262
Baumann Photo-Chemical Corp. 4-page brochure describes preparation, storage and replenishment for Acufine Chemicals. Gives a table of recommended developing times and ASA Indices for 35-mm, roll, and sheet films. Also describes properties and use of the Acufine paper developer.

YARDNEY SILCAD BATTERIES 263
Yardney Electric Corp. 6-page brochure describes rechargeable silver-cadmium batteries, with technical data on the electrical and physical characteristics of the silver-cadmium batteries.

TECHNICAL SUPPLIES BULLETIN 264
Consolidated Electrodynamics. Bulletin 1639-1, 2A describes and illustrates two special Datarite recording papers, Types 22 and 33, and two special processing chemicals for use in Datarite magazines, Type 49943-3 and Type 49943-4 developer solutions. Includes price lists.

PHOTOGRAPHIC PAPERS 265
Mimosa American Corp. 8-page price list for Mimosa Photographic Papers.

EDWAL MINICOL 257
Edwal Scientific Products Corp. Three-hole punched bulletin describes Edwal Minicol developer. Includes instructions for use, keeping characteristics and precautions.

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NEW PRODUCTS

For additional information on any new product circle the appropriate number on the readers' service card, page 77.

PRINT DRYER 105
The Arkay Corporation claims a three-way improvement in its entire line of Photo-Dry Electric Print Dryers. They include a "lock tension" device for even tension over the complete apron, a stronger canvas apron and a refined surface finish. The eight dryer models are priced from $11.95 to $54.95.

3-D CAMERA 108
The Stereoflex Camera, capable of taking high-speed photographs in 3-D, has been announced by the Benson-Lehner Corp. The Stereoflex uses special 35mm film and accelerates from a standing start to a film speed of 127 miles per hour in less than one second, then holds a steady synchronous speed. According to the manufacturer, it is believed to be the fastest accelerating camera ever built and has application as a rotary prism camera with or without stereo.

TAPE DISPENSER 109
Seal-O-Matic Dispenser Corp., has announced a cellophane tape dispenser called the Cello #72, which accommodates tape widths of ¾-in. up to 2-in., with cores of up to 3-in. It features a handle stop which may be adjusted for precision measuring.

ZOOM LENS CORRELATOR 101
A Zoom Lens Correlator with follow focus attachment, said to give accurate alignment of the cross-line in the lens reticle with the cross-line of the camera, has been announced by the Camera Service Center. It is claimed that this device will prevent displacement of the center frame when zooming from wide-angle to telephoto position. A large knob with calibrated built-in focal length distances controls zoom smoothness, and permits the operator to predetermine zoom by selecting and locking-off focal length distance.

INSPECTION LENS 110
Magnalens, a plastic magnifying lens for close inspection and small parts assembly, is a new product of Recarr, Inc. It provides a 6 x 6 in. magnifying area; and its shatter-proof cast acrylic plastic lens is claimed to withstand production line abuse while eliminating the danger of cuts and gashes. Featuring edges ground square for undistorted vision, its three-power lens is adaptable to the photographic, graphic arts and laboratory fields. Weighing 10 ozs., it has a holding force of more than 60 lbs. The Magnalens is available with an optional 10-in. extension arm and is mounted in an adjustable yoke.

DRI-MATE 104
An accessory for heat process office copy machines, which enables them to reproduce permanent black on white copies of any color visible on paper, is the Triangle Business Machines, Inc., Dri-Mate. To get all-color reproduction the original material and the sheet of photocopy paper are fed through the heat process machine and then through the Dri-Mate. It is claimed that the unit will also develop metal plates for use in offset printing. Price: $79.50.

MOVIE FLOOD LIGHTING 106
A 650W sealed beam type motion picture flood lamp has been developed by the Westinghouse Electric Corporation. A PAR-36 type sealed beam lamp, 4½ in. in diam., it provides light comparable to four standard 300W R30 flood lamps. Prices: lamp, $5.45; complete lighting unit including bulb, holder and cord—$19.95.

Meet the demand for continuous processing of WIDE paper

New Pakopak B/W Prosser & Dryer processes and dries roll paper in widths up to 11"

VERSATILE—3½", 5", 8" or 11" width paper can be processed in the new B/W Pakopak at a rate of 48" per minute per strand. Several combinations of listed sizes are accommodated. This rate of output can be increased by addition of a wet section and larger dryer. Processing is done at 85°F.

COMPACT—If you can spare a space 10' 3" by 34½", you can enjoy the convenience and profit that come with the B/W Pakopak continuous processing system. The Pakopak extends just 42" into your darkroom, its height is 52". And it's economical . . . to operate, as well as to purchase.

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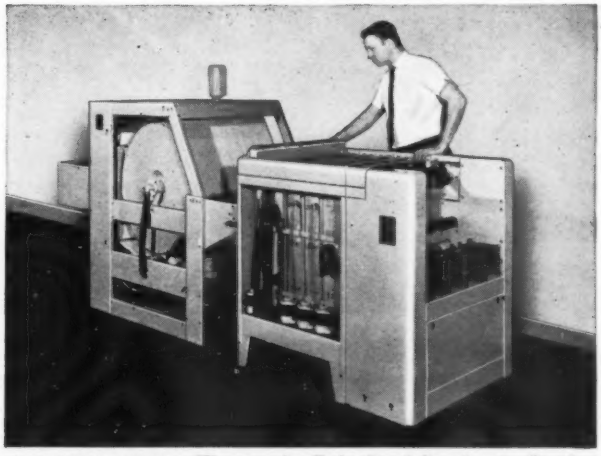

FASTER PROCESSING—The popular Pako Dual Continuous Leader Belt System saves time and labor by allowing you to run any length paper you wish. Pakopak Prosser includes Solution Circulation-Filtration to keep solutions agitated and clean. Pakopak Dryer features chrome-plated, stainless-steel water heated drum. Drum temperature is automatically controlled by thermostat.

PAKO CORPORATION

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Minneapolis 40, Minnesota

Get more information. Circle 476, page 77

LINHOF TRIPOD HEADS 102
Two Linhof tripod heads with a special leveling device controlled by a built-in spirit level for quick camera placement on uneven ground are being distributed by the Kling Photo Corporation. The Leveling Professional Panhead designed for 2¼ x 3¼ and 4 x 5 cameras and 16mm movie cameras is priced at $59.50. The Leveling Reporter Panhead for all 35mm and twin lens cameras and 8mm movie cameras is priced at $24.50. Cable releases that operate through the panning handle are available as accessories.

PRESCRIPTION LENS HOLDER 103
An adapter that makes it possible to fit a prescription spectacle lens in the eyepiece assembly of the Arriflex-16 has been produced by the Arriflex Corporation of America. The adapter is designed so that the prescription lens is permanently placed in a small sub-assembly, which may be slipped on and off the finder eyepiece. A blank slip-on ring is available in cases where one camera will be used by several people. Prices: lens holder (without lens), $28; blank ring, $8.

GEARED TRIPOD HEAD 113
Davis & Sanford Co., Inc., have announced a geared head for "Floating Action" Tripods, which permits adjustment of up and down motion within an 180 degree range, plus an easily manipulated separate control for side-to-side tilt. Available with 4 x 5-in. platform, or 2-in. round platform. Price: $37.50.

COLORTRAN LIGHTS THE WORLD...from sunny California to the remote corners of the globe you'll find Colortran for sale or rental, lighting the way for motion picture and still photographers. Because of its compactness Colortran travels with you to the wide-open spaces and to otherwise inaccessible areas on sets and on location. Whether you work with color or black-and-white film Colortran offers you more trouble-free illumination for less money. Continually refined, improved, and perfected, Colortran is indispensable to those who demand flexibility and high standards.

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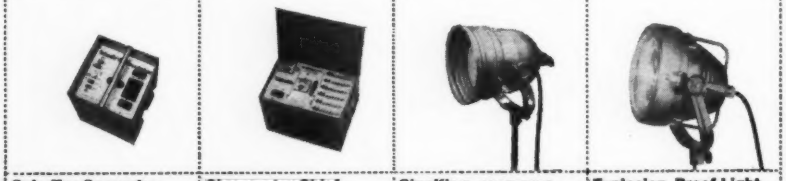

ColorTru Converter 120 volt lamps (3400°K) output 3500 watts of light $49.50	Cinemaster Chief Mark II controls ten 500 watt PAR lamps (3400°K) $309	CineKing - accommodates both 300 watt PAR 56 and 500 watt PAR 64 lamps $42.95	Explosion-Proof Light all the features of CineKing—also custom designed to order $128

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Get more information. Circle 473, page 77

SPEEDMASTER 111
Speedmaster, a color analyzer capable of reading the color balance of a 20-time enlargement, has been announced by Midwest Aerial Photographic Survey, Inc. With this analyzer, it is said, color variation can be read with an accuracy of .01 filter density—a reading claimed by Midwest to be five times more accurate than the minimum .05 printing filter. Meter illumination lights, color channel indicator lights and correct filters for color channels are selected automatically by one control on the probe. Price: $695.

SLIDE COVER GLASS
Eastman Kodak Co., has introduced a thin slide cover glass for use in certain units of its slide-viewing equipment. Kodak Slide Cover Glass (Thin) for 2 x 2 in. slides, with a thickness of 0.030 in. will replace 2 x 2 in. Kodak Slide Cover Glass, which has a thickness of 0.040 in. This reduced thickness allows for the use of Kodak glass-mounted slides in Kodak Cavalcade Slide Trays, No. 1, and Airequipt Magazines. This new product is being sold in unit packages of 50 sheets.

Q-BEAM 115
A compact movie light featuring a single 650W quartz lamp which delivers illumination equal to 4 conventional flood lamps has been announced by Acme-Lite Mfg. Co. Called the Q-Beam "Uniflood," this light consists of a quartz lamp sealed in a heat resistant glass envelope, vacuum-sealed against dust and tampering. It is surrounded by a heat-resistant plastic housing with a series of air vents at top and bottom, permitting the unit to be cooled automatically. A Cool Finger Grip built into the back of the lamp housing permits the user to fix the lamp at any angle to 90 degrees for bounce light effects. Has exposure guide for ASA 16 and ASA 40 films. Price: $23.00.

SLIDE FILE 114
The Stak-Pak, a container that holds three Ansco "Tag-Along" slide trays, has been produced by that company. These containers can be nested on top of each other with an interlocking device that holds them securely in place. Each container door has a snap lock that prevents trays from falling out if the unit is bumped or moved. Six self-stick labels for identification are included with each Stak-Pak. Price: $4.

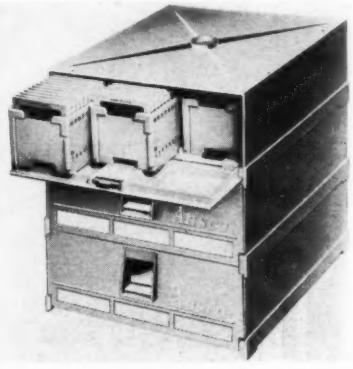

Photo slide filing system

A Multiplex slide file cabinet *protects* slides against damage or loss . . . has cylinder type key lock. Also provides for *orderly classification* by product, location, year, etc. And, it is *convenient*—slides can be viewed without removing from slide frame. Cabinet shown holds 2340 slides 2" X 2" . . . or 780 slides, 4" X 3¼" . . . or some of each. Other capacities available. Office furniture gray or green. For Bulletin LS-158, print your name and address in margin and mail this ad to:

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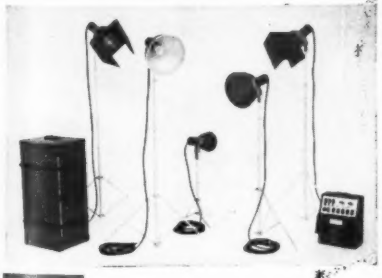

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BATTLEY DISC 112

A battley disc accessory with a series of concentric circles for fine inspection and identification work is available from E. W. Pike & Co., Inc. The disc fits into the bottom housing of 5X and 7X Flash-O-Lens units, which are available in both battery-operated and electric plug-in models.

AMIDOL 116

Amidol, a developing agent that will process in acid as well as alkaline solution is available from Ilford, Inc. A fine white or bluish white crystalline powder, the developer is made by dissolving in a solution of sodium sulfite, without other alkali. When used with bromide papers it produces cold-black tones. Amidol is available in sizes from 25 to 5000 grams.

ROLLAKIT 117

Rollakit, a rapid film processing kit, has been announced jointly by Cormac Chemical Corp. and U.S. Photo Supply Co., Inc. It permits simple processing of popular size black-and-white films and is intended for hand-in-hand use with the Rollaprint contact printer. Total processing time to achieve a dry negative ready to print is said to be about 15 minutes. The Rollakit consists of a film loading compartment, a bottle of Rollabath single-solution developer and fixer, a special processing tank and two film clips. Price: $12.95.

STEREO-TELEVISION KIT 120

A system that is said to convert any closed-circuit television equipment to a three-dimensional picture in minutes is now available from Stereotronics Corp. According to the manufacturer, the system is entirely optical, requiring no electronic changes in existing television equipment. It consists of three devices: a Stereo-Captor that fits on the front of the TV camera lens; a Stereo-Screen which is placed in front of the receiver; and Stereo-Glasses, which are worn by the viewer. Price: $895.

SLIDE WALLET 121

Irv Rubin Enterprises has announced production of The Slide Wallet, designed for carrying and displaying 2 x 2 color slides. The wallet holds 21 slides, 35mm or 1⅝ in. sq., mounted in any conventional cardboard, glass or plastic frames. It permits easy viewing of all slides, utilizing any convenient light source. Its design permits quick removal or replacement of any slide. Price: 98¢.

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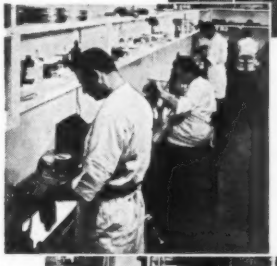

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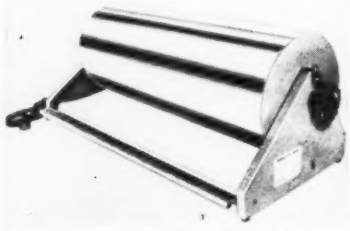
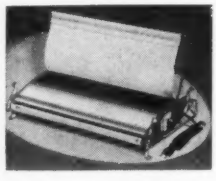
Twin Surface Pro Speed Model!

Exclusive Features include most usable surface, canvas even-tension device, faster drying, heavy cast base. Choice of 8 $55.00 up.



Premier Rotary Deluxe Dryer—with deluxe convenience and speed features for drying either glossy or matte finish prints $27.50 up.



Premier Print Dryers — Adjustable heat for matte or glossy print. Preshrunk canvas aprons. Standard and deluxe models from $12.00

New! Premier Stainless Ferrotype Plates Duo-Finish Stainless Steel! For highest gloss color and B/W prints. Won't Rust, Peel, chip! No base metal, no plating! Solid Stainless! Both sides usable! 4 popular sizes $2.95 up.

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Get more information. Circle 480, page 77

COMPACT TAPE RECORDER 124

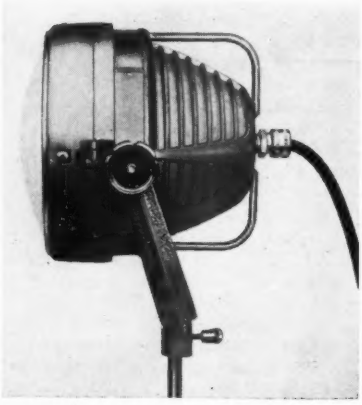
A two-speed miniature transistor tape recorder weighing 5 lbs. and measuring 2¼ x 7½ x 6⅝ has been produced by Craig Panorama, Inc. The Model TR-403 operates on penlight batteries and is equipped with microphone and case, reel case and earphones. Available accessories include a foot switch, telephone pickup and AC adapter to convert battery power to standard 115V AC.

AIR SQUEEGEE 123

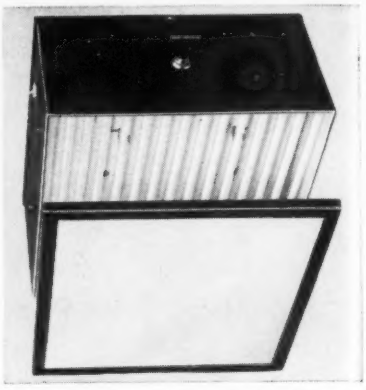
The Gryphon Corporation has announced an Air Squeegee, the Model HB-2, designed for use on any 16mm or 35mm continuous film processing machine. Using a combined Venturi-Airfoil principle, this unit is said to remove all surface liquid from the film, minimizing solution contamination, wash water usage and drying time. Water spots are completely eliminated from the film, it is claimed. Price: $100.

EXPLOSION-PROOF LIGHTS 122

The ColorTran Explosion-Proof Light, LCKS/64WP, used in the recording of missile launchings on closed circuit TV, is now available as a catalog item from the Natural Lighting Corp. This light was designed and engineered specifically for use in hazardous environments with PAR 64 Lamps. These 12 lb., 10 in. lights are said to provide usable photographic light equal to a 5000W Conventional Studio Key Light when controlled by the ColorTran Converter. Price: $120.



The ARISTO COLD LIGHT



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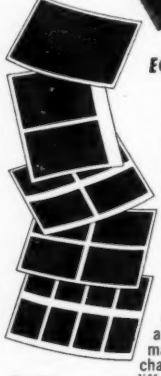

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This easel does the work of power units costing hundreds of dollars more. Ideal for the small color laboratory, professional or inplant photographer setting up color operations. Here's how . . . Use the easel to make your filter pack and exposure tests first, then expose from 1 to 8 prints on 8x10 paper in color or black and white automatically in total darkness as fast as exposure time allows. The focusing masks make the easel light tight. You change filters, focus and print different negatives or sizes on the same sheet, without removing the sensitive paper from easel.

Special Masks on order

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Big, bigger, or biggest . . . our color prints are just exactly what you *look for* in quality reproduction from original art work, transparencies, or negatives. No need to *hunt* for the process or the place that produces a perfect color print every time. *We* do, and we give speedy reliable service to boot. Competitively low prices, of course. For example: a big print 40" x 60"—$160.

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PP OF A CONFERENCE

(continued from page 52)

WEDNESDAY, AUGUST 2

9 AM, "Glamourizing the Black Box," Lee A. Ellis, Raytheon;
10 AM, "Color by Various Light Sources," Tom Knowles, General Electric;
11 AM, "Ultraviolet and Infrared as Detection Tools," Det. Charles O'Hara, New York Police Department;
1:30 PM, "Justifying the Qualified In-Plant Photographer," Walter Benson, Olmsted AFB, Penn. This paper discusses the uses of cost accounting and time-study systems in proving the worth of an in-plant section as against hiring photo service on a per-job basis.

A three-part discussion of "Photography under Extreme Conditions" begins at **2:15.** Speakers include:

Tim Sheehan, Port of New York Authority, "High Heat & Humidity;"

Duane Banks, U. S. Dept. of Mines, "Photography in Explosive Atmosphere;"

Fred Anderegg, U. of Michigan, "Photography in Remote Areas."

Frank Elam, Armco Steel, will follow on "Baird Evapograph Techniques."

THURSDAY, AUGUST 3

The day will be spent at Fort Monmouth, home of the Signal Corps photo and electronic labs. The tour will cost $4, including bus fare and lunch.

The morning session will cover "Instrumentation Photography," "Rapid Processing" and "USASRDL Film Report 1961."

The afternoon sessions will include: "Gremlins in the Darkroom," Howard Kirby, Eastman Kodak, a discussion of the mysterious why's and wherefores of negative and print defects. Gremlins include contaminated solutions and equipment, improper agitation and sometimes, just bad luck.

"The Orthographic Camera and Its Applications" will be described by Richard Kinstler, Proctor & Gamble. Roddy Boger, USN Ammunition Depot, will conclude with "Time-Lapse Photography."

FRIDAY, AUGUST 4

Opens with "Operation of the Smaller Photographic Unit" by M. L. Wayne, Remington Rand Univac, at **9 am** and concludes with a Methods and Techniques Forum, led by James Hampson, starting at **10 am.**

Unfortunately, there was no room to include the various social activities planned for the ladies nor of the trade show and combined functions.

ANY **ONE** KILFITT BASIC KILAR LENS CAN FIT **ALL** YOUR CAMERAS!

It's smart to save money. Smart photographers own only one lens of each focal length and use the same lens on different makes of cameras. They use Kilfitt Basic Kilars, ingeniously designed so they can be switched from camera to camera merely with the change of an adapter or flange (available for more than 25 popular 35-mm. and 2¼ x 2¼" still, and 16-mm. and 35-mm. movie cameras).

Kilfitt Basic Kilars are the long-time favorites of press, movie, commercial and other professional photographers for their versatility and economy, and because they are lightweight, highly color corrected and renowned for critical sharpness and brilliance. They come with screw-in lens shade, f/stop preselector and an actual test plate photographed with the lens you buy*. Only Kilfitt offers you this indisputable assurance of finest quality!

Focal lengths of Kilfitt Basic Kilars: 150, 300, 400 and 600 mm.; unique 90-mm. Makro-Kilar, focusing from infinity to 8", also available in Kilfitt Basic Kilar mount. For more information, see your dealer or send 10¢ to address below for booklet.

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Modeling light inside flash bulb. What you see you get.

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HYPERSPEED STILLS

(continued from page 40)

Four main approaches to the problem are represented in the listing. They are the Kerr Cell, the electric spark, the optical-mechanical shutter and the newest idea of the lot, the image converter.

The operating principle of the Kerr Cell is that some fluids change their polarizing properties in an electrical field. By combining a cell of such a fluid with a polarizing filter, the system can change from relatively opaque to relatively transparent via a surge of electricity in proper position in relation to the cell of fluid. As far as PMI has been able to determine, the shortest exposure on record with a Kerr Cell system is 5 nanoseconds. A good deal of light is lost in polarizing filtration. Furthermore, a picture at 5 nanoseconds requires 10 million times as much light as a picture 1/20 second, and besides, a film is likely to suffer considerable reciprocity failure at such a brief exposure. Obviously, the subject has to be quite bright to get a picture at the upper limit of Kerr Cell performance, but there are some very bright subjects that are very interesting, too.

Like the Kerr Cell, the spark gap depends for its brevity on the possibility of supplying a surge of electricity for a short time. In a system discussed below, a potential is built up between a cathode and an anode separated by an airspace in a glass tube. A trigger circuit alters the insulating property of the airspace, permitting a brief, intense discharge. Such a system is applicable to non-luminous subjects—but at very high speeds, the spark-to-subject distance must be relatively small so that sufficient light can be reflected to record on photographic film. Ambient light at a high level can destroy the action-stopping ability of the system, as can luminosity in the subject.

The optical-mechanical shutter employs a pair of crossed polarizing filters, in effect. To open the shutter, one of the pair is rotated 90 degrees. Being a mechanical device, its top speed is limited, but it, too, has a place in high-speed research.

The image converter is a marriage of electronic and photographic image recording. A video image is permitted, by means of an electronic gate, to bombard a cathode-ray tube with an image for a brief span of time. This image is recorded with a photographic camera during what is, in effect, an open flash exposure. The resolution is essentially the resolution of the CRT. Besides its very high speed (3 nanoseconds have been reported), the system is capable of magnifying the brightness of the subject by both electronic and photographic means.

SHUTTER LISTING

(continued from page 42)

can be controlled photoelectrically, electrically or manually.

■ Microflash Electronic Flash Unit, $975. Used to take the photograph on page 41 at .5 microsecond. Its flash lamp is a guided spark in a low inductance discharge circuit, energized from .05 μfd capacitance charged to 18 kilovolts. A phototube is built into the trigger unit and a microphone is supplied. According to the manufacturer, black-and-white photographs can be taken at f/8 on Panatomic-X film with lamp-subject distance 2 ft.

SPACE TECHNOLOGY LABORATORIES, 8929 S. Sepulveda Blvd., Los Angeles, Calif.

■ STL Image Converter Camera, $20,000. Takes framed photographs at exposure times varying from 3 nanoseconds to .2 microsecond. Three-picture series can be made at rates of half a million to 20 million exposures per second and streak photographs may be taken at writing speeds of four to 1,000mm per microsecond.

Interchangeable plug-in units provide a choice of high-speed or standard speed framing pictures and high-speed or extended time writing rates. The camera is equipped with interchangeable backs which permit it to record on either 2¼ x 3¼ sheet film or on a Polaroid back which takes the standard 3¼ x 4¼ picture roll.

Focusing is accomplished with the aid of a direct view lens which allows the operator to view the fluorescent screen of the image converter tube.

The objective lens is a Carl Meyer Anastigmatic, 125mm, f/2. The rear optical system where the image appearing on the I.C tube's fluorescent screen is recorded on film, is composed of two lenses mounted front to front: a Schneider Xenon, 125mm, f/2 and a Carl Zeiss Biotar, 75mm, f/1.5. This system works at f/1.5 and at a reduction ratio of 5:3.

Applications include plasma physics, hypervelocity ballistic research, shock tube work with events of 1 microsecond duration and less.

WORKING PHOTOGRAPHER

(continued from page 12)

of paper by light leaks if the color head on the Omega enlarger isn't closed tightly all the way. Jay simply installed a microswitch which closes the circuit of the lamp *only* when the filter slot is tightly and properly closed.

Tom Knowles of GE gave a good rule for setting up a projection screen and viewing seats: be sure the last row of seats is no farther back than 6 times the width of the projection screen. This will keep captions on slides, (properly made of course) legible.

You can see that a two- or three-hour session of this kind of audience participation can be very stimulating. Ideas and suggestions pour out, gadgets of all types are exhibited as adapted for photography, and money-saving, time-saving systems are disclosed. Jim Hampson has done such an excellent job in stimulating industrial photographers to join in, that this annual affair has become one of the most popular at each National Industrial Photographic Conference. Hope we'll see *you* in New York at this one!—THE END.

PHOTO INSTRUMENTATION

(continued from page 26)

struct an X-ray source producing a number of pulses within milliseconds. Zenith has built a prototype of such equipment with which a bullet has been stopped in flight twice within a few microseconds. With this technique the recording cannot be done with normal motion picture cameras. The exposures can be superimposed on a single film or a drum or streak camera can be used. There is also a new development of the Rauland Corp. which seems promising in this direction: the shutter image converter tube. With this tube it is possible to record up to 16 images on different places of its output phosphor, the minimum exposure time being in the millimicrosecond range with a minimum time between frames of one microsecond. The output phosphor is of relatively long persistency so that 16 images can be recorded by conventional means on one piece of film.—THE END

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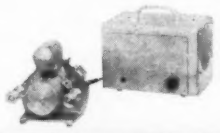

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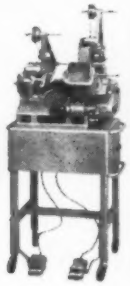

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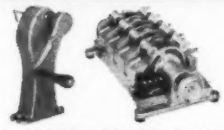

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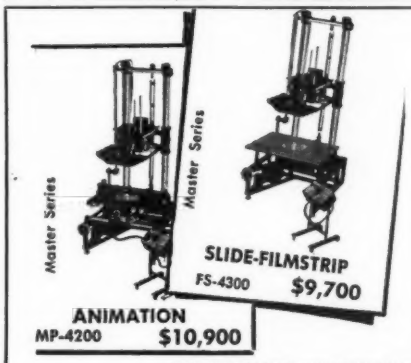

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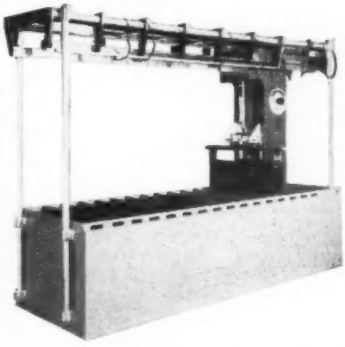

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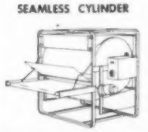
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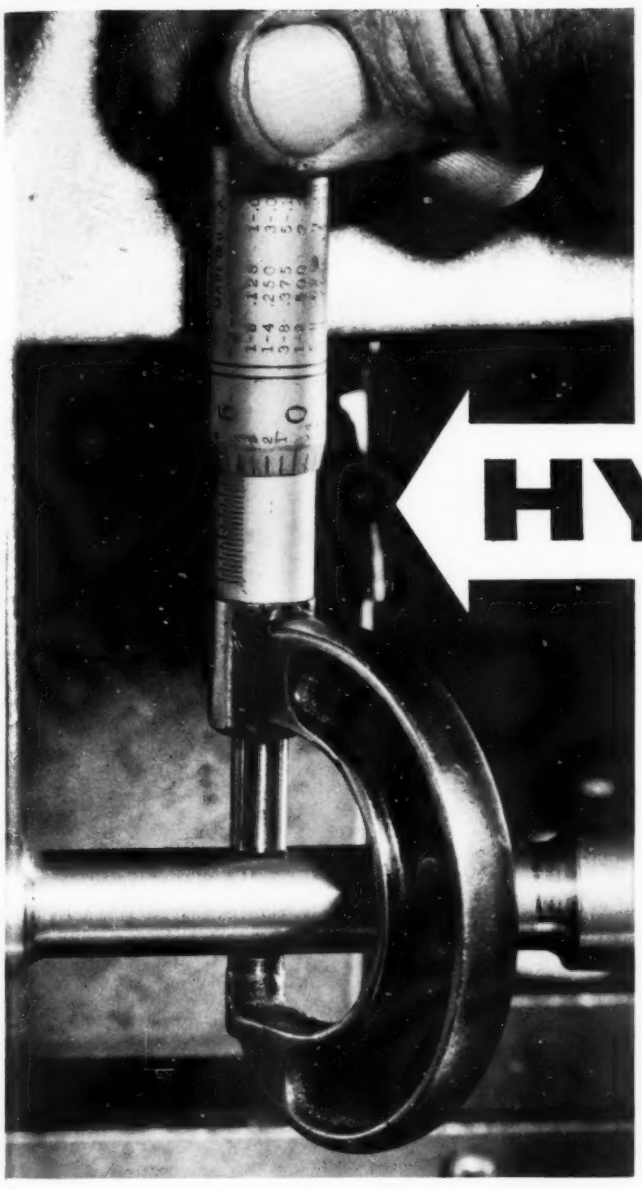

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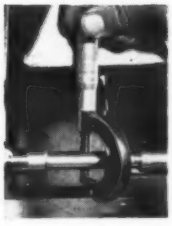

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This modern developer is available in one gallon and 3½ gallon sizes at a price that gives more value than any high acutance developer now available. For new sharpness at high film speeds, try Hyfinol with Super Hypan® film. Ask your Ansco salesman for a demonstration.

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NEW

with last-instant exposure control

35mm Reflex

with full-area ground glass and split-image rangefinder

System

Kodak Retina Reflex III Camera

This precision camera complements your photographic skill, whether used by itself or with the many photo aids making up the Kodak Retina System.

The new Kodak Retina Reflex III Camera lets you set exposures manually, or it does it for you with an automatic exposure control, even while you look through the finder. Great for last-instant exposure checks. It also features through-the-lens, parallax-free viewing and focusing with full-area ground glass or rangefinder, and efficient flash synchronization, electronic flash at shutter speeds up to 1/500 second.

Your picture-taking scope is greatly enlarged by the Retina System of photo aids. There is a choice of wide-angle and telephoto lenses, 28mm to 135mm—all coupling with automatic controls on the camera.

Ultra close-ups are easy with sets of close-up lenses. With the f/2.8 model, take pictures as close as 5⅞ inches. For copying—including 24 x 36mm transparencies—there's the Kodak Retina 1:1 Copying Kit; for photomicrographs, the Retina Microscope Adapter Kit. Many other useful photo aids, such as screw-in filters, lens hoods, right-angle and sports finders, and carrying cases.

The new Kodak Retina Reflex III Camera and its photo aids can answer all your equipment requirements. Or it can serve you as a quality 35mm camera to complement your present camera equipment.

See it at your Kodak dealer's.

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